THE ADOPTION AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN TEACHING AND LEARNING AT TOWNSHIP SECONDARY SCHOOLS IN SEDIBENG WEST DISTRICT MUNICIPALITY

By

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I declare that **THE ADOPTION AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN TEACHING AND LEARNING AT TOWNSHIP SECONDARY SCHOOLS IN SEDIBENG WEST DISTRICT MUNICIPALITY** is my own work and all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

G.Chisango   28 August 2019

Signature   Date

DEDICATION

To my children yet to be born.

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ABSTRACT

Information and communication technologies (ICTs) can be used to facilitate teaching and learning, regardless of location and time, hence institutions of learning are adopting the technologies. This study explored the adoption and use of information and communication technologies (ICTs) at township secondary schools in Sedibeng West District, Gauteng Province, South Africa. A mixed method approach was adopted to gather data from the research participants. Focus group discussions and in-depth face-to-face interviews were conducted to inquire into how the participants felt about the adoption and use of ICTs in teaching. In addition, a survey questionnaire was administered to teachers to investigate the extent to which they integrate ICTs in teaching, ICT training and support needs available for teachers, and challenges faced by teachers in their use of ICTs in the classroom.

The results of this study indicate that intrinsic and extrinsic factors were barriers to the adoption and use of ICTs in teaching. These barriers included limited ICT skills among teachers, inadequate ICT infrastructure, negative attitudes towards ICTs, theft and vandalism of the infrastructure, and a lack of school-based ICT technicians at the schools. The older and more experienced teachers preferred using traditional teaching methodologies, whereas the younger and less experienced teachers were willing to integrate ICTs in teaching. This study concludes that although teachers were faced with a lot of challenges, some of them had positive attitudes towards the use of ICTs in teaching. This study proposes an ICT model which comprises five core aspects of adoption and use of ICTs in teaching: planning, ICT training, ICT support, ICT implementation and evaluation. The study further recommends that teachers, the community and the department of education officials' work together in order to address the challenges identified in their schools.

Key terms: The information society, the digital divide, technological pedagogical content knowledge (TPACK), information and communication technologies (ICTs), secondary schools and South Africa.

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LIST OF ABBREVIATIONS

ACE – Africa Coast to Europe

ANA - Annual National Assessments

CK - Content knowledge

CTO - Commonwealth Telecommunications Organisation

DA - Democratic Alliance

DoE - Department of Education

DTPS - Department of Telecommunications and Postal Services

EC – Eastern Cape Province

ELRC - Education Labour Relations Council

FS – Free State Province

GCIS - Government Communication and Information System

GDP - Gross domestic product

GHS - General Household Survey

GNI - Gross national income

GP – Gauteng Province

ICASA - Independent Communications Authority of South Africa

ICT - Information and communication technology

ICTs - Information and communication technologies

IDI – Information and Communication Technology Development Index

IPB - Information and Communication Technology Price Basket

ISAD - Information society and development

ISPs - Internet Service Providers

IT - Information technology

ITU - International Telecommunication Union

KZN – KwaZulu Natal Province

LDCs - Less Developed Countries

LMS - Learning management system

LP – Limpopo Province

MDCs - Most developed countries

MEC - Member of the Executive Council

MP – Mpumalanga Province

MPCC - Multi-purpose community centre

MTN – Mobile Telephone Network

NC- Northern Cape Province

NCS - National Curriculum Statement

NEIMS - National Education Infrastructure Management System

NPC - National Planning Commission

NSC - National Senior Certificate

NW – North West Province

OECD - Organisation for Economic Co-operation and Development

OWG - Open Working Group

PCK - Pedagogy content knowledge

PK - Pedagogical Knowledge

RSA – Republic of South Africa

SA – South Africa

SACE - South African Council for Educators

SITES - Second information technology in education study

SMS – Short message service

SPSS - Statistical Package for the Social Sciences

TIMSS - Trends in International Mathematics and Science Study

TK - Technological Knowledge

TCK - Technological Content Knowledge

TPACK - Technological Pedagogical Content Knowledge

TPK - Technological Pedagogical Knowledge

TSC - Thusong Service Centres

TTLC - Tanzania Telecommunications Company Limited

UK – United Kingdom

UN – United Nations

UNESCO - United Nations Educational Scientific Organisation

UEW - University of Education, Winneba

USA – United States of America

USAASA - Universal Service and Access Agency of South Africa

USD – United States Dollars

WACS - West Africa Cable System

WC – Western Cape Province

WSIS - World Summit on Information Society

WWW – World Wide Web

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CHAPTER 1

BACKGROUND AND AIMS OF THE STUDY

1.1 Introduction

With information and communication technologies (ICTs), an individual is able to gather, create and disseminate information. The convergence of ICTs has shrunk the world; there is instant communication across the globe via technologies, such as the mobile phone and the internet. Electronic learning has been made possible by the presence of converged ICTs. There is, therefore, a need to change the curriculum and teaching methodologies, and to train teachers information and communication technology (ICT) skills in the ever-changing technological world. Adequate ICT infrastructure in schools and in the communities should also be provided. There is however, digital exclusion of some individuals, especially in the third world. These individuals are in war-torn regions, poverty stricken rural and peri-urban communities. Such communities have inadequate ICT infrastructure, lowly-educated persons and a limited and/or no supply of electricity at all.

Rapid growth in ICT usage has made a pervasive impact on society and on individual lives (Yeun, Law & Wong 2003). Thus, investment is being channelled towards the use of ICTs in education across the globe. It is, therefore, not surprising that the National Department of Education of South Africa has an e-learning policy which was put in place in order to spread the use of ICTs, thereby developing digital skills among learners and teachers in schools. Information and communication technologies connect teachers and learners to the global village where vast information is shared.

The e-learning policy of South Africa is that,

> Every South Africa manager, teacher and learner in the general and further education and training bands will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need as lifelong learners to achieve personal goals and to be full

> participants in the global community) by 2013 (South Africa Department of Education Government Gazette Volume 470 No. 26734 2004:18).

However, du Plessis and Webb (2012a) argue that the time frames for ICT implementation in South African schools, as reflected in the Draft White Paper on the Education (Department of Education 2004), have not come to reality for some learners. Such learners are in rural and poor urban schools, which neither have computers and internet connections, nor have the teachers been exposed to ICT-related skills and practices.

The current Member of the Executive Council (MEC) for the Gauteng Department of Education, Mr Panyaza Lesufi, has, however, started rolling out tablets and smart boards in schools in the province. The MEC acknowledged the importance of ICTs in education. He argued that the future of education lies in technology, and bringing technology to schools in Gauteng Province meant that the province took lead in improving the education system in the country (Makhubu 2014). It is against this backdrop that this research study sought to explore the adoption and use of ICTs at some secondary schools in the Sedibeng West area, South Africa.

1.2 Background to the study

Sedibeng District Municipality is situated at the southern tip of Gauteng Province. It comprises Emfuleni, Lesedi and Midvaal Local Municipalities and is 40 kilometres away from Johannesburg. The study focused on Emfuleni Local Municipality, which had 220 135 households and a total population of 721 663 (South Africa Statistics: Emfuleni 2011). Emfuleni Local Municipality has two education districts, which are Districts 7 and 11. District 7 is dominated by Model C schools (quantile 1). Such schools were formerly for white learners only. On the other hand, District 11 (quantile 4), comprises mainly disadvantaged township schools.

Furthermore, household goods in Emfuleni Local Municipality indicate that not everyone has access to all ICTs. According to South Africa Statistics (2011), only 25. 2 per cent of the households had a computer, 7.I per cent accessed Internet at home, 91.9 per cent had cell phones, and 59.4 per cent had no internet access at all. Socio-economic development issues also result in the unequal access to ICT resources and the digital exclusion of some segments of the poor people in society, especially those who survive on minimum wages (Hacker & van Dijk 2000). Information inequality might also be a result of escalating costs of ICT services and goods. In 2011, 45 per cent of the economically active youth in Emfuleni, who were 15 to 35 years of age, were unemployed and 34.7 per cent of the total economically active population was also unemployed (South Africa Statistics: Emfuleni 2011). Based on these statistics, it can be said that the high rate of unemployment leads to poverty. Thus a few dwellers possess ICT goods in the local municipality. Some of the Emfuleni residents might be more concerned with putting food on the table than having ICT goods. Therefore, not only limited or lack of ICT skills hinders some individuals from accessing ICT goods, but also poverty and the ICT price basket.

1.3 The need for the study

The aim of the study was to explore the ICTs adoption and use in the teaching and learning process at some township secondary schools. The introduction of ICTs in the classroom requires a lot of change among its users (Marcovitz 2015), for instance, in terms of pedagogy. Du Plessis and Webb (2012b) state that the concepts of learning and knowledge have been changed by the use of the internet. Learning can take place anywhere and anytime. Learners themselves are able to independently gather new knowledge and share it on the internet. The then Minister of Education, Professor Kader Asmal, echoed the same sentiments when he said that the introduction of ICTs to schools would enable learners and teachers to engage in new ways of information selection, gathering, sorting and analysis (South Africa Department of Education 2003). Raising ICTs literacy of teachers and students and also preparing them for life in a networked society is one of the major objectives of adopting and using ICTs in schools (Jayson, Nash & Flora 2014).

Some professionals are not certain about how to integrate ICTs into the curriculum and how to use suitable methodologies (Tan Wee & Subramaniam 2009). Some teachers are digital immigrants who were never exposed to technology-enhanced education at teachers' training colleges and universities. Some students also come from families which have little or no knowledge at all of ICT skills to manoeuvre on the internet and seek for information, as well as collaborate with others. It can thus be stated that e-learning might be relatively new to some secondary schools especially in the disadvantaged communities (Holmes & Gardner 2006). Holmes and Gardner define e-learning as the use of modern technologies, including the internet, to enhance the quality of learning by enabling access to resources, distant interaction and collaboration among learners. This thesis sought to explore schools' readiness to adopt and use technology in teaching and learning. The school comprises the learners, teachers, the school management team, which includes the school principal, the heads of departments, the parents and the community at large. This study, however, only focused on teachers and the school principals.

South Africa as a nation has two worlds in one, the developed and the developing worlds. This also has an impact on ICTs access and use among the population. Township schools are poorly resourced, compared to some schools situated in the middle-and-upper class communities (South Africa: Department of Education 2004). Learners from affluent schools are exposed to different types of ICTs both at home and at school. Those from poor townships, farms and rural areas might not be exposed to all the new technologies, hence creating a digital divide among learners. In a bid to close the digital divide among learners, the Gauteng Provincial Department of Education MEC, has embarked on a project of supplying schools with tablets. The national government of South Africa also has some ICT initiatives and projects that are meant to develop teachers' ICT skills, improve access to ICT infrastructure and relevant information pertaining to school curriculum, among other things.

However, Van Dijk (2005:4) argues that "the digital divide is deepening where it has stopped widening". In places where most people are motivated to gain access and physical access is spreading, differences in skill and usage come to the fore. Other barriers to the integration of ICTs in schools include the attitudes of teachers, their beliefs in teaching and learning, and mere resistance to new technologies (Du Plessis & Webb 2012b). Hence this study sought to investigate

ICTs adoption and use at some secondary schools in the Sedibeng West District Municipality, Gauteng Province, South Africa.

1.4The information society and the digital divide

The information society and the digital divide provide the context of this study. In an information society, all individuals are linked to communication networks, such as the internet, which is a source of information. This is not, however, necessarily true in Sub-Saharan Africa where the larger part of the population is disconnected from the internet. Unequal access to, and use of, ICTs creates digital divide at societal, national, continental and global levels.

1.4.1 Webster's conceptualisation of the information society

Webster is one of the researchers who studied the information society and has identified five ways of defining an information society: technological innovation, occupational change, economic definition, spatial definition, and cultural definition (Webster 2005, 2006, and 2008).

Technological definition

This theory is built on the suggestion that social transformation is the consequence of modern technologies (Albright 2005). In the same vein, Castells (1994) argues that the technological information revolution is the backbone of all structural transformations and portrays an information society. The internet provides infrastructure for an information society. Information and communication technologies (ICTs) such as personal computers, satellite television, and computer-to-computer communication have already impacted on personal lives, business, politics and education in ways beyond imagination. The convergence of ICTs services promotes easy access to information and interaction among people, leading to a better-informed society.

Economic definition

The economic definition of an information society is grounded in the importance of information in economic activities of a society. The fast growth of information technologies has had an impact on some economies. Economies that are driven by powerful ICTs are defined as Knowledge-Based Economies (Sebina & Mazebe 2014). An increase in the use of ICTs further strengthens the formation of a Knowledge-Based Economy and an information society. A society is, therefore, called an information society if there is a growth in the proportions of gross national product accounted for by the information business (Webster 2006).

Occupational definition

Occupational change is another measure of the rise of the information society. The argument is that a society is regarded as an information society when the majority of jobs are informational work (Webster 2005). That is, the information society has arrived when there is an increase in information-related jobs, such as librarians and researchers, and a decrease in occupations in industry (such as coal miners and steel workers) and agriculture (such as farm labourers) (Webster 2008). Castells (2004) explains that the use of digital technologies in the information labour automates manual labour out of existence.

Spatial definition

This perspective emphasises information networks which connect people and places in different geographic locations. The information networks provide an "information ring main" to homes, shops, universities, offices and mobile people (Barron & Curnow 1979; Webster 2008). Reliance on networks reduces the restrictions of place on modern-day activities. Therefore, networks allow instant communication (Castells 2004). Networks are also expanding reach and capacity by bringing together people and organisations that are separated by continents (Nath 2009).

Cultural definition

The cultural conception of an information society is linked to our everyday life (Nath 2009). The modern society has witnessed an increase in the information in circulation due to technological advances (Webster 2003; Nath 2009). Information and communication technologies enable “the death of distance” and the “end of geography”, giving rise to global culture (O'Brien 1992; Cairncross 2001). The rise of the global culture is, thus, a consequence of the information society, and ICTs are of great importance in shaping the new culture.

1.5 The digital divide

Information and communication technology (ICT) inequality problems date back to as far as the late 1960s and the early 1970s. With the inception of the internet, scholars and world leaders began to ponder the consequences of unequal access to it (Warschauer 2004). Discussions about ICT inequality were held and distinctions were made between global inequalities and national inequalities by world leaders of international organisations such as the United Nations and the World Bank. The digital divide has been described by the United Nations as a new type of poverty that is dividing the world (Ibrahim 2009). Information and communication technologies play a central role in the globalised world. Lack of access to, and use of, ICTs results in information poverty. Individuals geographically located in rural and remote areas, and in some disadvantaged parts of urban areas in developing countries, are the most affected by exclusion from digital advances in ICTs. Some individuals in poor communities cannot afford having ICTs such as a computer and an internet connection, hence rely on out-dated information.

1.5.1 Van Dijk’s types of access

Access to and use of ICTs is generally increasing but disparities in the use of ICTs exist. This researcher is of the view that focusing on impediments to access and use of ICTs, and effective participating in the information society is a necessity. Van Dijk's multifaceted access model provides an understanding of the phenomenon.

Motivational access

The importance that individuals place on ICTs motivates them to acquire the technologies. Individuals who are on the "wrong" side of the digital divide have motivational problems. It appears that not only "have nots" exist in society but also "want nots" (van Dijk 2012). Social and mental factors explain motivational access. It is posited that the main social explanation is that the low-income and low-educated individuals do not like the internet (Katz & Rice 2002). The mental explanations postulated are computer anxiety and technophobia. Fear, discomfort and stress experienced when confronting computers all explain computer anxiety (Brosnan 2002). Technophobia is a fear or dislike of technology in general. These phenomena are decreasing especially in industrialised nations and it is not the case in most non-industrialised nations, especially in Sub-Saharan Africa, where computer and internet diffusion is still low.

Material access

Material access means having access to hardware, software, applications, networks, and the degree to which ICTs can be used by individuals (Fuchs & Horak 2008; van Dijk 2008). Material access, thus, entails physical access and costs for hardware and software (van Dijk 2005). Material access also includes peripheral equipment such as ink, paper, and subscription costs. A decrease in hardware costs might result in individuals purchasing more devices. Income is, thus, an important factor. When the physical access gap is closing, income disparities remain important for material access (van Dijk 2012).

Skills access

After acquiring the motivation to use computers and other ICTs, and physical access to them, an individual has to learn to effectively use the technologies. The problem of skills such as multimedia literacy and computer skills might appear. The concept digital skills was introduced by van Dijk (1999) and Steyaert (2002).

Scholars involved in information processing in a network society have called attention to different kinds of digital skills needed for the effective and efficient use of computers and the internet. Individuals who possess information skills easily participate in the cyberspace, they easily exchange information, are well linked and effectively networked (Castells 2004).

Usage access

The actual use of ICTs is the ultimate goal of the total process of access. Necessary motivation, material access and the digital skills to use technologies are essential but inadequate conditions of actual use. The use of ICTs has its own determinants. These include the time used, the applications used, the use of broadband or narrowband, and the creative use of technology (van Dijk 2012). The implication is that closing a physical access gap does not necessarily mean that the usage gap closes in a society.

1.6 The global divide

Digital divide is prevailing in the world. It is one of the most serious problems in the 21st century, with developed countries enjoying high connectivity while developing countries, such as those in Sub-Saharan Africa, have either limited connectivity or are disconnected. The global digital divide describes global inequalities, between industrialised and non-industrialised countries, with regard to access to ICTs and the opportunities of becoming part of the global information society. Inequalities in access to, and use of, technologies systematically places certain social groups in disadvantaged positions. The wealthy industrialised countries are heavily wired with ICTs, while the non-industrialised countries have poor ICT infrastructure.

Sub-Saharan Africa has the least developed ICT infrastructure in the world and the inhabitants of the region have a severe lack of ICTs skills (Dutta & Bilbao-Osorio 2012). Similarly, Burke (2012), and Wentrup, Strom and Nakamura (2016) argue that Africa's ICTs penetration rates and access numbers remain low and behind levels in other developing countries. It is further elaborated that even the well-equipped centres of excellence in Africa have less bandwidth than a home bandwidth user in Europe and North-America (Bornman 2012). Internet penetration rate is slow in the Sub-Saharan African region due to poor infrastructure, inappropriate technology policy, high prices and low bandwidth in domestic backbone networks.

1.7 The social divide

Inclusion and exclusion are digital divide dynamics related to the digital divide which articulate the levels of ICTs resources that individuals have access to. The social divide is another aspect of the digital divide, which concerns the information haves and the information have-nots in each country. Information have-nots are not only found in developing countries but also in developed countries leading in the information society (Norris 2001). Within the developing parts of the world, some segments of society are socially excluded; they are incapable of using services that are considered normal for a developed society (Chigona & Mbhele 2008). Social stratification such as geographical location, gender, age, family status and language result in different types of the social divide (Wilson 2006). Social stratification also relates to disparities in participation in the information society.

1.8 The democratic divide

The democratic divide refers to the dissimilarities between those who utilise the digital technologies, the internet in particular, extensively to play a part in public life and those who do not (Kassam, Iding & Hogenbirk 2013). The democratic divide is an example of the second level divide, which concerns internet usage divides (Min 2010). Internet usage is what Norris (2001) calls the democratic divide, which concerns the different levels at which people use the internet for political reasons. The democratic divide implies that some individuals are politically marginalised in the information society.

1.9 Technological pedagogical content knowledge (TPACK)

This study is also informed by the technological pedagogical content knowledge (TPACK) framework (Mishra & Koehler 2006). This framework is an extension of Shulman's (1986) notion of pedagogical content knowledge (Wilkin, Rubino, Zell & Shelton 2013). For teachers to effectively teach, they need to know the methodologies that best suit learners and blend the methodologies with the content of a particular subject (Shulman 1986). The teacher's knowledge on how to blend pedagogy and knowledge is what Shulman terms pedagogy content knowledge (PCK). Shulman's work was extended by Mishra and Koehler (2006). Mishra and Koehler (2006) integrated technology as an additional element to pedagogy and content knowledge. Technological pedagogical content knowledge is an interplay "between technology, pedagogy and content knowledge" (Wilkin et al 2013:47). These three (TPACK) form a unified whole for assisting educators benefit from using technology to develop student learning (Jaipal & Figg 2010).

The ICT literate levels of teachers can also be analysed using this framework. Teachers need to be confident in content, pedagogics and technological knowledge domains so that they can increase student learning and engagement. The classroom environment and available ICT resources also have an impact on how the teachers use technologies. The extent to which teachers are using technologies at some schools in the teaching and learning process can only be found out through research, hence this study sought to explore the ICT adoption and use at some secondary township schools.

1.10 Information and communication technology (ICT) uses in education

The use of ICTs in education throughout the world has gained attention and investments are being channelled towards the use of technologies in education. Information and communication technology is believed to be the vehicle that will assist schools in changing from the "Industrial to the Information Era…" (Tubin 2006:13). Adoption and use of ICTs in schools is a requirement because "Essential 21st Century Skills" are a necessity for learners of today; digital skills prepare the learner for life using ICTs (du Plessis & Webb 2012a:341). The ability to use technologies such as computers and other modern ICTs in the classroom prepare the student for the world of work where digital skills are required in the globalised economy. Hence, the South African National Department of Education (DoE) has a number of important lifelong skills which include critical thinking, collaboration among learners, critical analysis of information and effective use of technology (du Plessis & Webb 2012a). Thus, the rise of the global economy powered by ICTs has implications for the purpose of institutions of learning. Schools should encourage the attainment of knowledge and skills, including digital skills that enable lifelong learning.

1.11 ICT initiatives and projects in South Africa

The national South African Department of Education acknowledges that the quality of education in the country is below international standards and a collaborative effort is required to improve education (South Africa: Department of Education 2007). The quality of teacher training and developmental programmes play a significant role in determining the overall quality of education. The teachers have the most direct contact with learners and have considerable control of the teaching and learning environment and what is taught. Improving teachers' teaching skills and knowledge of the subject content is one of the crucial steps to improve learner achievement (King & Newman 2001), hence the introduction of some ICT projects in South Africa in a bid to improve the standard of teaching and learning in schools.

1.12 Approaches to e-learning

E-learning is a significant aspect in the information society. If properly adopted and applied, e-learning can improve teaching and learning at institutions of learning. It is an effective mode of communication in educational institutions. The introduction of e-learning to institutions of learning is meant to improve educational delivery and prepare the learners for the information age (Adu 2016). The use of e-learning facilities increases learners' creative and intellectual capabilities, required in the information society. E-learning devices such as the internet and the computer allow the teacher and the learners to contribute to the learning process through for instance discussion forums. E-learning promotes independent learning among learners and can, thus, prepare them for lifelong learning. E-learning can be divided into three types: synchronous, asynchronous and cohort learning (Elkins & Pinder 2015). In the context of this study, blended learning (the use of two or more learning events in different formats) is used at schools (Gonza´lez 2012). In other words, blended learning is a combination of technology-enhanced learning and face-to-face teaching (Negash, Wilcox & Emerson 2007). The teacher and learners meet in the classroom and electronic devices such as tablets, smart boards and computers are used in teaching and learning.

1.13 ICTs implementation in South African schools

The availability of ICTs at schools does not automatically imply that the technology is used for effective teaching and learning. There are factors that hinder the adoption and use of technology. Intrinsic and extrinsic factors either prevent teachers from adopting and using ICTs in teaching and learning, or motivate teachers to use technology in teaching. Intrinsic factors either motivate or demotivate teachers from using technology but do not account for other factors, such as economic factors and classroom realities.

1.14 Definition of key concepts

This section focuses on defining and explaining key terms in this research. Key terms are defined in relation to the context of the topic under study. The key terms that will be explained are ICTs and universal access.

1.14.1 Information and communication technologies (ICTs)

Information and communication technologies includes telecommunication and computer technology to transmit information and cut across different geographical locations, compressing space and time (Holmes 2004). This definition only focuses on telecommunication and computer technologies for the transmission of information to different areas, but does not include other devices such as hand-held calculators and projectors. A detailed definition of ICTs for teaching and learning is stated by Olele (2014:114) thus:

> The full range of computer hardware, computer software, and telecommunications facilities. Thus it includes computer devices ranging from hand held calculators to multi-million worth super computers. It includes the full range of display and projections devices used to view computer output. It includes the local area networks and wide area network that allow computer systems and people to communicate with each other. It includes digital cameras, computer games, CDs, DVDs, cell phones, telephones, telecommunication satellites, and fibre optics. It includes computerized machinery and computerized robots.

In this study Olele's definition of information and communication technologies is used because it includes a wide range of technologies used in the teaching and learning process.

1.14.2 Universal access

For e-Learning to be a success, there should be universal access to ICTs for all students, regardless of their socio-economic status. Universal access is the provision of ICTs to people at affordable prices and the services should also be easily accessible to all citizens, regardless of an individual's location. In some rural parts of South Africa, such as in Limpopo and KwaZulu Natal provinces, people travel long distances to access multipurpose community centres and even a mere telephone due to poor signal in the remote areas. Accessibility to ICTs in South Africa, therefore, differs in relation to an individual's geographical location. Those in large cities, such as Cape Town, Johannesburg and Durban, easily access ICTs. Issues of levels of ICT skills and affordability should not be ignored. The issue of affordability of telecommunication services in South Africa is a cause for concern. For instance, the country's fixed-line costs were ranked 119th and mobile-telephony 103rd out of 200 economies, by the International Telecommunication Union (2015). Hence Pimienta (2011:39) argues that "universal access" ought not to be only understood "in terms of geographic cover but also in terms of economic cover".

According to the Department of Communications (2014), the aim of universal access is to increase access to communication services on a shared basis. Previously shared access to communication services referred to accessing public pay phones. Universal access has recently changed to tele-centres and cyber laboratories which are online. Information and communication technologies, such as the internet and cellular phones, expand access to public services, such as health and education, communication and access to job markets, thus promoting digital inclusion (ITU 2016). The Government Gazette No. 26734 of 2004 states that accessibility to reliable infrastructure such as the internet and electricity is a necessity for e-learning to be a success at schools. E-schools will also be accessible to the local communities so that members develop their ICT skills and make use of ICT services.

1.15 The aim of the study

This study is an exploratory and descriptive study aimed at investigating the adoption and use of ICTs in secondary schools in predominantly black residential areas.

1.15.1 The research objectives

To achieve the above stated aim, the following research objectives are addressed:

- To identify the technologies available at schools for teaching and learning purposes.
- To investigate teacher readiness to use the identified technologies in the classroom.
- To establish factors that influence the integration of ICTs in teaching and learning.
- To proffer possible solutions to challenges faced by teachers in their adoption and use of ICTs in teaching.

1.15.2 Research question

The study's main research question is:

To what extent have teachers in township schools adopted ICTs in teaching and learning and what are the factors hindering and/or promoting the use of ICTs by teachers in these schools?

To answer the main research question and gather information on the adoption and use of ICTs by teachers at township secondary schools, the following sub-research questions are addressed:

1. Which ICTs are available for teachers to use in teaching and learning at schools?
2. To what extent are the teachers ready to use the technologies in teaching?
3. Which factors influence the integration of ICTs in teaching and learning?
4. What are the possible solutions to challenges faced by teachers in their adoption and use of ICTs in teaching?

1.15.3 Selection of schools

Three township secondary schools were selected for the research and one for the pilot study. Non-probability or purposive sampling was used to select the four schools. Purposive sampling is "the selection of certain individuals whose qualities are of importance to the study" (Tongco 2007:147). Selection of the cases under study was done by approaching Sedibeng West District Education Department officials of the government to identify schools that have computer laboratories and or tablets, as well as smart boards in Emfuleni Local Municipality. Schools for this study were selected from the obtained list of schools, that the Education officials had indicated that they had the ICTs.

The schools were purposively selected for the study for the following reasons:

(a) They share the same characteristics in that they are township secondary schools and were all given tablets and or computers and smart boards by the

Gauteng Provincial Department of Education to use in the teaching and learning process.

(b) The three schools were chosen in the mentioned municipality over other schools in the district because I am quite familiar with Emfuleni Municipality, which makes it easier for me to conduct her research.

(c) Focusing on schools in the same local municipality cuts travelling expenses for me.

1.16 Research methodology

In this study, a case study research design was used. A case study is a detailed investigation of a phenomena and this could be “an individual, a group, an institution, a community or a profession” (Gilham 2010:1). This research study focused on three cases, that is, township secondary schools and investigated adoption and use of ICTs at the selected cases.

One of the strengths of a case study is singularity, which permits the researcher to focus on the uniqueness and complexity of a single case (May 2011). The case study is important in this study because this research study explored ICTs adoption at each particular school, in its unique environment. Different kinds of evidence were sought in each case setting, such as the available ICTs infrastructure, how the available ICTs were being used at the school and the school’s readiness to use the available ICTs in the teaching and learning process. All these aspects were explored to get the possible answers to the research questions.

The case study research design allows the researcher to investigate single or many units of study. In this study, the mixed method was employed (Denzin 1978). With regards to the mixed method, in-depth face-to-face interviews and focus group discussions were used to collect qualitative data and the survey questionnaire was used as a quantitative method. Mixed method is a plan of action that prevents biases that result from the use of a single methodology. By combining methods, the researcher “can overcome the deficiencies that flow from one method" (Babbie & Mouton 2010:275). Mixed method allows the researcher to gain more information from the research participants and respondents. It also increases the reliability of the findings through collecting qualitative data through face-to-face interviews and quantitative data through survey questionnaires. Face-to-face interviews allow the researcher to probe for responses from the research informants. Therefore, mixed method is aimed at deepening the understanding of issues under study.

1.16.1 Survey questionnaire

A survey questionnaire was employed to collect data in this study. Paper-based self-administered questionnaires were used to collect quantitative data from teachers. Through the questionnaire, this research study was able to explore issues such as ICT literacy levels among teachers, their readiness to use technologies in teaching and the support given by the school principals as well as the Department of Education.

A survey questionnaire is best suited for this study because it allows many questions to be asked and gives the researcher some flexibility in analysing the data collected (Babbie & Mouton 2010). Furthermore, a questionnaire does not only allow a large quantity of data to be collected at the same time over a short period of time, but also allows a variety of information to be collected from participants, such as the demographic information of the teachers and their readiness to use ICTs in teaching (Thomas 2003). Participants can provide the information in the absence of the researcher. Questionnaires also allow the participants to take their time to read carefully and answer the questions.

1.16.2 In-depth face-to-face interviews

In-depth personal interviews were employed to collect data from the school principals of the three secondary schools under study. Semi-structured interviews were used to find out how the principals felt about the adoption and use of ICTs at their schools. The in-depth personal interview allows the researcher to seek clarity on issues misunderstood and might even take the informant back to issues discussed earlier for further elaboration (Babbie & Mouton 2010).

Qualitative research permits the creation of new ideas and emphasises the construction of theoretical interpretations (Neuman 2006). Thus, the researcher does not only focus on a specific question, but considers the theoretical and philosophical paradigm in an inquisitive, open-minded setting (Neuman 2006). This is relevant to the study because it allowed this researcher to keep on probing participants through in-depth face-to-face interviews and get a deeper understanding of issues related to ICT adoption at some secondary schools. Leedy and Ormrod (2005) posit that the situation is described in rich detail and the readers can draw their conclusions from the data presented.

1.16.3 Focus group discussions

Qualitative data were collected through focus group discussions with teachers. Focus group discussions offer the interviewer a means of obtaining an understanding of a wide range of views that participants have about a specific issue as well as how they interact and discuss the issue (Conradson 2005; Mishra 2016). Participants were asked, for instance, how they integrated ICTs in teaching and learning, the ICT support programmes available for them, and the challenges that they faced in the use of ICTs in teaching. Participants for this study were encouraged to talk among themselves. This researcher relied on the participants' interactions to solicit qualitative data (Creswell 2014).

1.17 Data analysis procedure

This section explains how data were analysed in this study.

1.17.1 Survey Questionnaire

Data collected through the survey question were analysed by means of a software package, Statistical Package for the Social Sciences (SPSS). Quantitative data were statistically analysed by use of descriptive statistics such as frequency analysis and mean scores. One-way analyses of variance

(ANOVAs) were employed to establish the significance of the difference between the three schools. Post-hoc Scheffe tests were further calculated to explore differences among the means. The Kaiser-Meyer-Olkin (KMO) test was used to measure the sampling adequacy of variables. Pearson correlations were used to investigate the strength of association between variables.

1.17.2 Interviews

A thematic approach was used to analyse qualitative data. A thematic analysis includes deciding on the number of concepts to be coded and also deciding on coding for the existence or rate of occurrence of a concept (Babbie & Mouton 2010). Data were arranged into themes related to the sub-research questions, for analysis.

1.18 Ethical considerations

In this study, the research ethics were considered. Data were collected from human subjects through in-depth interviews and a questionnaire survey.

1.19 Delimitations of the study

The delimitations of this study are that it only focused on three township secondary schools in the Sedibeng West District, South Africa. This research study only focused on teachers and the school principals to explore ICTs adoption and use at township secondary schools.

1.20 Conclusion and outline of thesis

This chapter has attempted to give a general overview of the study. Developing countries have low ICTs infrastructure penetration compared to the developed countries. Access to, and use of, ICTs is therefore, limited to a few individuals in developing countries, especially in Sub-Saharan Africa. Unequal distribution of ICTs in a society creates the digital divide, which leads to information poverty to those who are on the wrong side of the divide. There is also limited ICTs infrastructure at some disadvantaged schools. Thus, governments, including the national government of South Africa, have embarked on rolling out the infrastructure at some schools and affording ICT supporting programmes to some teachers. However, there are challenges with the implementation of ICTs at some schools in predominantly black areas.

It is against this backdrop that this thesis is divided into nine chapters.

In the first chapter, the research problem and its setting are explained, giving an overview of the study. The background of the study is outlined, which leads to the statement of the problem, significance of the study as well as the conceptual framework of the study. The aim of the study and research questions were also stated in this chapter.

Chapter Two critically defines the information society and the digital divide, and their implications for the developing countries. These concepts provide the context of this study. The theories further inform the development of the questionnaire and the interview guides for teachers and school principals.

Chapter Three further discusses the information society and the digital divide in Africa, with specific reference to South Africa. A discussion is done of inequality with regards to access to, and use of, ICTs in Africa and South Africa, where this study is situated. An assessment of South Africa's position in the information society is done using the International Telecommunications Union's ICT Development Index (IDU).

Chapter Four discusses the role of ICTs in teaching and learning. It also explains how ICTs can be integrated in teaching. ICT initiatives and projects in South Africa are also outlined. Factors which affect the use of ICTs the classroom are discussed.

Chapter Five examines the technological, pedagogical and content knowledge (TPACK) framework. The adoption and use of ICTs in teaching requires a technologically competent teacher. Thus, this chapter dissects the TPACK framework and that enabled this researcher to craft some of her research questions.

Chapter Six discusses the research methodology used in this study. Justification of the research design, instrumentation and data collection procedures is done. Data collection methods which were used are in-depth face-to-face interviews, focus group discussions and a survey questionnaire. Ethical considerations are also discussed.

Chapter Seven presents qualitative research findings obtained from interviews. An interview guide was used to conduct semi-structured focus group discussions and in-depth face-to-face interviews with teachers and school principals respectively. Qualitative data was analysed thematically to identify themes. Thick narrative descriptions of the themes were presented.

Chapter Eight is a presentation of quantitative findings gathered through a survey questionnaire. The Statistical Package for the Social Sciences (SPSS) was used to analyse the quantitative data.

Chapter Nine concludes the study. An ICTs model based on the qualitative and the quantitative findings as well as the literature reviewed is proposed. Recommendations for future research on ICTs adoption and use at schools are made.

CHAPTER 2

THE INFORMATION SOCIETY AND THE DIGITAL DIVIDE

2.1 Introduction

A revolution has swept the world into an info-sphere where ICTs have momentously changed societies. The powerful role of ICTs in the development of societies has led many to ponder over the consequences of inequitable access to them (Thunman & Persson 2013; Sanfilippo 2016). This chapter, thus, critically defines the information society and its accompanying threat, the digital divide.

The information society and the digital divide provide the context of this study. The information society is here and it cannot be reversed; "like a force of nature, the digital age cannot be stopped" (Sarrocco 2002); Negroponte 1995:229). Nations recognise the importance of ICTs in the information and knowledge society, as much as they recognise the fact that inequality in the distribution and sharing of ICTs and accessing information also exist. Disparities in accessing and using of technology in a society gives rise to the digital divide. Information society discourses are related to the digital divide and disparities in accessing and using of ICTs (Bornman 2016). Similarly, disparities in accessing and using of ICTs has resulted in the digital divide becoming part of the information society discourses (Askonas & Stewart 2000; Molina 2003 & Warschauer 2004). Africa and specifically Sub-Saharan Africa, is prominent in the discourses on digital divide (Fuchs & Horak 2008). This chapter focuses on defining the information society and the digital divide and their implications for the developing world, and Africa and South Africa more specifically.

2.2 The concept of the information society

The concept "information society" evolved from concepts such as the computer-serviced society (Sackman 1967), the age of cybernetics, the computer revolution, the information era (McLuhan 1968), the knowledge society (Drucker 1968), the wired society (Martin 1988), the telematics society (Martin 1988) and the post-industrial society (Bell 1973). The commonalities between these concepts relate to knowledge, knowledge production and ICTs (the internet or mobile phones). Two issues associated with discussions of the information society are defining the informational dimension of a society and measuring the extent to which certain dimensions of a particular society is deemed informational. Regardless of different proposed terms, scholars such as Bell, Drucker and McLuhan agree with the notion that information society "is a new form of organisation of the social and economic life" (Becla 2012:126).

2.3 Defining the information society concept

The conceptualisation of the information society is complex. It is difficult to decide the exact meaning of the concept and determine if individuals are actually members of that society (Duff 2000). Scholars and organisations approach the concept "the information society" from diverse viewpoints and there does not exist a universal accepted definition. Al-Nasrawi and Zoughbi (2015) argue that though there is no universal definition, there are elements forming the foundation of the information society which are generally accepted, such as information and knowledge, the increase of ICTs and access to, and use of ICTs.

The information society concept can be drawn from Fritz Machlup's (1962) work. Machlup identified information service sectors such as education, media of communication and information technologies (Lyon 1988). For Stehr (1994), a knowledge society means that "the age of labour and property is at an end". Thus an information society is described as a society in which information activities are more important than physical labour (Machlup 1962; Porat 1977; Bezold & Olson 1986). Concurring with Machlup, Porat and, Bezold and Olson are Drucker (1968) and Rouse (2005) who posit that in a knowledge society, the economy depends upon knowledge rather than manual labour, and social expenditure has shifted from goods to knowledge.

The structure of the economy in an information society is radically changed by the use of information (Stehr 1994). In the new economy, individuals work mainly with their minds rather than with their hands; it is ideas that count. Knowledge is a key resource. Therefore, it is a "weightless economy" (Thomas 2015). The individual in this era is regarded as the "information man" and is professed to be "educated, affluent, and well-travelled" (Wresch 1996, cited in Thomas 2015:29). The skilled user of information technologies is able to manoeuvre himself or herself in the information society. Furthermore, the change to a mostly technical global economy (Kelly 1988) is strongly related to McLuhan's idea of the "Global Village". With the advent of the internet, which compresses space and time, individuals, businesses, and governments are able to connect to the world faster, further, and at low cost (Cairncross 1997).

Technological determinists furthermore advocate for a technological definition of the information society. A technological view is posited by scholars such as Bell (1979) and Bangemann (1994). Bell defines the information society as a new integrated computer-telecommunication infrastructure that sends facts, ideas and judgements to individuals, families, organisations, communities and societies, in a connected society. Drawing from Bell's view of an information society, Martin Bangemann also formulated a technological definition of the information society for the Corfu European Council. He defines the information society as "the revolution based on information" (The Bangemann Report 1994:10). It can be deduced, from both Bell and Bangemann's definitions, that technological progress enables the processing, storing, regaining and passing of information. From a technological perspective, the internet is providing information unrestricted by space, time and volume, but only in areas where there is internet connectivity. The technological information revolution, therefore, portrays an information society which substitutes the industrial society as the basis of social institutions (Castells 1994). From the technological definition, it can be said that ICTs are continuously altering the way people work, shop and communicate. This implies that there is a need to adopt and use ICTs to keep abreast with changes.

The increased usage of ICTs in the global economy has resulted in the rise of "white collar" jobs, and an explosion of social and economic freedom. Information production was identified by Jonscher (1999), as the main occupation in the information society. The economist, Machlup (1984) identified a range of information categories such as “education, media and communication, information machines and information services” (Thomas 2015: 39).

The information society is also regarded as post-industrialist (Bell 1973; Webster 1997). According to Bell (1973), the post-industrial society is characterised by many changes in which property-bound social relations that are centred on a few existing elite and bourgeois individuals, are being eroded. Bell’s theory of post-industrialism projects the important role of information as central in the emerging information society. Bell argues that there is an undisputable rise in information in society, for instance, in the social and economic fields. Castells (2000) shares a similar view with Bell. He argues that the information technology revolution resulted in the emergence of informationalism, as the material foundation of the new network society. An information society, therefore, is a society in which information-related activities are prevailing, which implies sufficient infrastructure, education, access, and efficiency (Zachery 2009).

Another meaning of the information society concept is presented by Martin (1988) who describes the information society as a society in which improved quality of life and economic development depend largely on the extensive use of information. Technological advancement influences the education system, the market and the living standards in such a society (Martin 1988). Information is regarded as important for an individual to survive in such a society.

Webster (2005) defines five underlying characterisations of an information society that can be deduced from the postulated discourses. These are technological, economic, spatial, cultural and occupational dimensions.

2.3.1 Technological definition

Webster’s (2005) technological definition is based on the suggestion that “social transformation is the consequence of modern technologies” (Albright 2005:322). In the same vein, Castells (1998: 340) argues that the “technological information revolution is the backbone of all structural transformations” such as “in the relationships of production, in the relationships of power, and in the relationships of experience” and these portray an information society. Webster defines the technological concept as follows:

The technological conception centre on an array of inventions that have appeared since the late 1970s. New technologies are one of the most visible indicators of new times, and accordingly are frequently taken to signal the coming of an information society (Webster 2014:11).

The internet provides infrastructure for the information society. Innovations in ICTs, for instance, computers, satellite television, and computer-to-computer communication (such as email and data communication) transform the way that we live (Martin 1988; Webster 2006). These ICTs have already impacted on the lives of individuals, business, politics and education. For instance, distance education, facilitated by technologies, has benefitted individuals in both industrialised nations and non-industrialised nations.

Furthermore, the convergence of ICTs services promotes easy access to information and interaction among people, resulting in a better informed society (South Africa: Department of Telecommunications and Postal Services 2016). Farmers can, for example, access information on markets. In democratic societies individuals can participate in discussions on e-government platforms. These technological innovations have also influenced personal lives. ICTs can be used to communicate with family and friends. The accessibility of communications worldwide has facilitated the evolution and growth of multinational corporations. The exchange of information through technological innovations such as the internet heralds the information society (Webster 2008).

Webster (2006), however, points to the vagueness of describing an information society as technological. It is difficult to measure the amount of ICTs and stipulate the point at which a society has reached the appropriate level of technological sophistication to be typified as an information society. Another difficulty pertains to whether the technological definition refers to the adoption of ICTs at organisational level or individual ownership of ICTs. Another limitation, according to Albright (2005), is that technological theories do not address the issues of unequal access to ICTs in some societies and how that impacts on development. Inequalities in the adoption and use of ICTs create a digital divide in a society.

2.3.2 Economic definition

The economic definition of an information society is grounded in the importance of information in the economic activities of a society. If information business accounts for the greater part of the gross national product, then that signals a point at which a society can be called an information economy (Webster 2006).

The fast growth of information technologies has had an impact on most economies (Ukwandu & Nnamocha 2013). The use of ICTs boosts economic growth, especially in the developed countries (Farhadi, Ismail, & Fooladi 2012). Economies that are driven by powerful ICTs are defined as knowledge-based economies (Oh & Phillips 2013). In knowledge-based economies, knowledge practices are integrated in socio-economic hierarchies. An increase in the use of ICTs further strengthens the formation of a knowledge-based economy and an information society.

The economic definition of an information society also suggests that information economies are continuously more interconnected globally, as indicated by the increase in the number of transnational corporations and a growth in mergers and acquisitions throughout the world (Albright 2005). The economic value of information business, for instance education and publishing, is calculated over a period of time (Webster 2006). When the largest proportion of the economic activity is generated by information industries, then an information society can be identified. Information is, thus, an economic resource (Moore [sa]).

The economic definition of an information society has, however, been criticised by some scholars, such as Albright (2005). An increase in the economic growth of a country suggests an improved standard of living, such as an increase in access to education and healthcare. Improved standards of living, however, depend on the assumption that there is an even distribution of wealth in a given society, which may not be automatically true (Albright 2005). The existence of an uneven distribution of wealth in societies results in the social marginalisation of some individuals. Such individuals are unable to, for instance, access education, housing and employment.

2.3.3 Occupational definition

Occupational change is another measure of the information society. The conception of the idea of the occupational definition of an information society has been created by Bell (1973). Bell postulates that an increase in white-collar jobs heralds a post-industrial society. He further acknowledges the significance of information in the white-collar society (Bell 1973). Such a society has individuals who ‘‘think smart’’ and who are symbolic analysts, that is, they are people who think, plan and innovate, in the new "weightless economy" (Webster 2003). Information workers are highly educated and are key to future prosperity. Physical labour does not create wealth in this society. Ideas, knowledge, skills, and talent are used to create wealth (Leadbeater 1999).

It is postulated by Terranova (2000) cited in Bell (2006:271) that:

"…we are less and less creatures of flesh, bone and blood; we are more and more creatures of bits and bytes moving around at the speed of light."

Thus, the information man is quickly replacing the farmer and the industrial worker. The argument is that a society is regarded as an information society when the majority of jobs relates to informational work (Webster 2003). That is, a society is becoming an information society when there is an increase in the number of information-related jobs, such as librarians and researchers, and a decrease of occupations in industry (such as coal miners and steel workers) and agriculture (such as farm labourers) (Webster 2008). Castells (2004) explains that the use of ICTs in the information labour automates manual labour out of existence. Castells further argues that the manual labourers such as those working on mines and on farms are not at ease in a networked society; they lack the required skills and are not part of the information society, hence Castells calls them the "4th world".

Furthermore, jobs are influenced by what happens in the global core of the economy. The global economy refers to an economy which has the capacity to "work as a unit in real time on a planetary scale" (Castells 1998:3). Technological, organisational and institutional activities are the core to the economy. The technological capacity, for instance, of the global economy, is its ability to structure the entire planet through telecommunications and information systems. The global economy is organised in networks and the internet is the technological basis of the economy. Businesses connect to each other, forming networks. Thus, the double logic of inclusion and exclusion cuts across countries, so the notion of a North and South divide no longer prevails. However, though nations are connected globally through networks, some segments of society, such as rural areas and shanty towns, are not part of the global economy (Castells 2001). Rather, they belong to a different, basic survival economy. Therefore, globalisation excludes some people on the planet, but at the same time affects everybody.

The global economy comprises a highly skilled labour force, with high educational qualifications, such a computer software engineers and financial analysts, and these are referred to as self-programmable labour. Self-programmable labour refers to people who have the ability to produce knowledge and information (Castells 2000). On the other hand, non-self-programmable labour or generic labour represents those individuals with no specific skills. It is not only education that distinguishes the two groups, but the quality of education. Therefore, it is not solely the accessibility of ICTs, but also the number of people in a country that obtains high levels of quality education at secondary school and tertiary level that determine its inclusion or exclusion from the information economy (Bornman 2012).

From a sociological perspective, the growth of information occupations has wide ranging societal consequences. For instance, employees in the high-technology sector may create a "new class" which does not interact with other social groups (Perkin 1989). These information workers have specialised skills, hence they tend to form exclusive social networks. Perkin (1989:2) comments that these professionals who are mostly situated in the developed world "rule by virtue of human capital created by education and enhanced by … the exclusion of the unqualified." Perkin further argues that as the number of these employees rises in the society, they are likely to displace outdated ideals of "co-operation and solidarity, of property and the market, and of the paternal gentleman with the professional's ethos of service, certification, and efficiency" (Perkin 1989:406). These employees are "intellectuals and technical intelligentsia" and are also termed a "new class" by Gouldner (1978:153). Therefore, from a sociological perspective, the information economy is about the relationship between social classes and power structures, which is a consequence of the increase in information occupations (Nath 2009).

The occupational definition of the information society has also not been spared from criticism. Porat (1977) categorised occupations that mainly involve production, processing or distribution of information. In the same vein, Jonscher (1983) discerns two sectors of the economy: the information sector and the production sector. The methodology for allocating workers to specific groups is objected to Robins and Webster (1987). The two authorities argue that a statistical figure of information workers does not show the multifaceted procedures by which researchers classify information occupations (Robins & Webster 1987). Furthermore, simply calculating the total number of workers in the information sector does not tell us anything about their ranking in positions (Webster 2003).

2.3.4 Spatial definition

This perspective emphasises information networks which connect people and places in different geographic locations (Webster 2006). The spatial definition of an information society "has at its core the geographer's distinctive stress on space" (Webster 2006:18) and is also not completely detached from sociology and economics (Nath 2009). In this wired society, people are connected through the information networks that operates at the local, regional, national, and global level (Barron & Curnow 1979). The information networks provide a flow of information to homes, shops, universities, offices and mobile people (Barron &

Curnow 1979; Webster 2008). Dependence on information networks decreases the limitations of place on modern-day activities, therefore networks allow instant communication (Castells 2004). Networks are also expanding their reach and capacity by bringing together people and organisations that are separated by continents (Thomas 2015). For instance, cities such as New York, London and Tokyo are spatially dispersed but are command posts of the world economy due to interconnectedness associated with information networks.

Telecommunication technologies, for instance the internet, allow instant communication globally. Examples are online shopping, online banking, emailing, video conferencing, and accessing information from online libraries. Industries which were previously confined to their geographical boundaries have expanded to unimaginable parts of the world. Information networks compress space and time, thus removing geographical constraints. An individual only has to be connected to the world-wide information networks for him or her to be part of the information society (Castells 1996; Nath 2009). The emergence of the information society is, thus, signalled by the growth of information networks. ICTs are important for networks to operate, and this calls for an individual's competencies and digital skills.

The spatial definition of an information society has been criticised due to a lack of precision. It is difficult to establish when exactly a society is deemed an information society (Nath 2009). The main idea is of information moving along information networks. No individual has ever been able "to quantify how much and at what rate information must flow along these routes to establish an information society" (Roszak 1986:13). It is also unclear what an information network is: is it two people having a telephonic conversation, a group of people having a webinar online, or is it the transfer of data over computer networks? (Nath 2009).

Some critics also posit that information networks have been in existence for quite some time. For instance, telegraph and telephone services were forms of information networks before the advent of the internet (Nath 2009). Modern ICTs might have enhanced the rate at which the networks were established, but that alone does not seem adequate “to make a case for a new era” (Nath 2009:29).

2.3.5 Cultural definition

The cultural definition of an information society is linked to our everyday life (Nath 2009). The modern society has witnessed a rise in the information circulating as a result of advances in technology (Webster 2003; Nath 2009). ICTs enable “the death of distance” and the “end of geography”, giving rise to global culture (Cairncross 2001). People have access to, for instance, a broad-spectrum of news and entertainment, from almost any corner of the world through ICTs such as the internet, television and the radio. The rise of the global culture is, thus, a consequence of the information society, and ICTs are of great importance in shaping the new culture. The cultural definition of the information society, therefore, centres on the immense increase in symbols - from fashion to media - and is greatly information-laden (Webster 2006). It is also about individuals exchanging and receiving information about themselves and others (Webster 2008). Furthermore, Hindman (2000) reasons that individuals who apply ICTs in a diverse manner enjoy the benefits of a new way of living in the information age.

The cultural definition also has limitations. Albright (2005) argues that although culture is acknowledged to be an important issue in the development and telecommunication context, it is only measured in quantitative terms. For instance, the United Nations Educational Scientific Organisation (UNESCO) compiles a report on culture annually. UNESCO collects quantitative data on “Literacy, Culture and Communication” and the statistics of radio receivers, daily newspapers, televisions, internet hosts and main telephone lines are collected (Albright 2005). The number of ICTs can be a measure of cultural change in some societies, but not so in others, such as nomads. Modernity has further excluded and marginalised some people, instead of connecting them.

From the view of this study and the premises discussed in this section, this researcher defines an information society as a society that can access and use ICTs to improve the standards of living and the working conditions of people. The use of knowledge is central in such a society. It has also emerged that ICTs and their effects are not equally distributed among peoples and regions. These inequalities will be discussed in more depth in the following section.

2.4 The Digital Divide

Inequalities regarding use of ICTs date back to as far as the late 1960s and the early 1970s (Aqili 2008). With the inception of the internet, scholars and world leaders began to ponder over the consequences of unequal access to information networks (Warschauer 2003). Discussions about ICT inequality were held and distinctions were drawn between global inequalities and national inequalities by world leaders of international organisations such as the United Nations and the World Bank. Different terminologies, such as the knowledge gap and digital inequality, were used to refer to ICT inequalities (Husing & Selhofer 2002). The term digital divide came into use after the former president of the USA, Bill Clinton, and Vice President Al Gore, used the phrase in Knoxville, Tennessee, in 1996 (Gunkel 2003). Clinton and Gore, however, did not come up with the term but only popularised it. The term “digital divide” was coined by Lloyd Morrisett (Hoffman, Novak & Chatterjee 1995). ICTs play a central role in national economic growth, the development of organisations and individual welfare (Selwyn & Facer 2010). However, concerns about the disparities associated with the information society rose due to the fact that not everyone has access to ICTs. Significant differences in accessing and using ICTs prevail among people within a country and among countries. It is believed that ICT inequalities can intensify economic disparities and sharpen social inequalities. The ICT inequalities in society are understood as the digital divide.

2.4.1 Defining the digital divide

The term digital divide is multi-dimensional. And as a result, this study focuses on some of the several dimensions that have a meaningful relationship to the adoption and use of ICTs (Okunola, Rowley & Jonhson 2017).

The United Nations postulates that the digital divide is a new type of poverty that is dividing the world (Ibrahim 2009). ICTs play a central role in the globalised world. Lack of access to, and use of, ICTs results in information poverty. ICTs are unevenly distributed in societies (Lesame 2013). Hence, digital divide discussions are part of the information society discourses (Askonas & Stewart 2000; Molina 2003; Warschauer 2004). This is echoed by Norris (2001) who states that the information society is creating parallel communication systems that escalate the divisions between the industrialised and non-industrialised nations. One communication system is for those with high income, who are connected to high speed internet, and access to a plethora of information at affordable costs. The other is for the disconnected individuals, obstructed by obstacles of time and price, and who rely on obsolete information (Holzer & Manoharan 2009).

Individuals geographically located in rural and remote areas, and in some disadvantaged parts of urban areas, are the most affected by exclusion from digital advances related to ICTs (Castells 2000; Choung & Manamela 2018). Some individuals in poor communities cannot afford having ICTs such as a computer and internet connection, hence rely on out-dated information. In developed countries, in contrast, ICTs are available, affordable and accessible for most individuals. The digital divide, furthermore, divides the globe into a "North-South" dichotomy (Ogunsola & Okusaga 2006), the "North" being the most developed countries and the "South" the developing countries. The digitally excluded are individuals excluded from network positions that enhance livelihood. These include not only the many people living in the South, but also the poor, the disabled and those located in remote areas (Castells 1997).

In the same vein, the digital divide is interpreted as related to the uneven infrastructure and information dissemination of ICTs "on a global scale, between regions and between towns and cities within countries", and also between people living in different parts of towns and cities (affluent suburbs and townships) (Warf 2013:37; Wentrup, Strom & Nakamura 2016). This definition does not, however, address the issues of ICT use and the quality of accessible infrastructure- factors that have become more significant (Mutula 2005). Accessing ICTs also does not necessarily mean that people make use of the technologies. Some individuals access ICTs but do not use the technology. Such individuals are depicted as technology “want nots” (van Dijk 2005). The quality of ICT infrastructure also contributes to a digital divide. For instance, an individual connected to high speed internet may access and disseminate information more easily than an individual connected to low speed internet. Furthermore, Warf (2013) and Wentrup et al’s (2016) definition of the digital divide might also imply that merely narrowing ICT access gaps addresses the digital divide. There are other factors, such as digital skills and affordability of ICTs which contribute to a digital divide. Adequate ICT skills are a necessity for individuals to meaningfully use the technologies. ICTs should also be affordable to all individuals in a society. Expensive ICTs hinder some people from using the technologies, especially those from low-income groups.

Furthermore, the embedding of ICTs in economic, social, cultural and democratic development systems is occurring and is experienced unequally by individuals across the globe (Ragnedda & Muschert 2013). The digital divide also mirrors the social disparities of access to ICTs, in particular the internet, and the results of this disparity for countries and societies. The term digital divide, thus, situates two issues. It centres on the issue of accessing ICTs and internet connections. The digital divide also goes beyond access and connectivity issues into digital literacy and skills (Castells 2001). Differences in digital access, use, services and skills add a central cleavage to prevailing sources of disparities and generate new differences in society, the so-called second level digital divide (van Deursen & van Dijk 2010).

Furthermore, Keniston explores the effect of language on the adoption and use of ICTs in the developing world. Language has a pivotal role in defining “who benefits, who loses, who gains, who is excluded, who is included…” (Keniston 2001:283). The adoption and use of ICTs can be enhanced by availing websites in local and familiar languages to users (Osborn 2010). Failure to accommodate different languages on the internet might exclude some individuals who are not conversant in English, the main language on the internet.

The Organisation for Economic Co-operation and Development (OECD 2001:5), defines the digital divide as:

> Gaps between individuals, households, business and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities.

The "new" digital divide is, thus, not only ascribed to the absence of ICT infrastructure or connections but, in its current form, is shifting from "basic to advanced communications and from quantity to quality" (ITU 2002:11). For instance, a connection to high speed internet is different from a connection to slow internet. Van Dijk (2012) also argues that the digital divide has shifted from motivational and physical access to digital skills and differences in usage.

ICT access gaps may be related to gender, age, and social class, type of employment, being employed or unemployed and/or being a habitant of a developed or developing country. In developing countries, the digital divide also means dissimilarities in ICT access between rural and urban people (Lesame 2013). Digital divide within a country is a consequence of several factors, such as disparities in ICT infrastructure, digital literacy, and the affordability of ICTs. Digital literacy refers to the ability to apply technology in relevant situations in order to properly function in the digital society.

There is an increasing number of people who are online in Africa, but the internet is still accessed by only a few individuals (Olatokun 2008). Hence Africa and other non-industrialised segments of the world are characterised as information "have nots". Less Developed Countries lag behind in ICT based jobs, e-libraries, e-government, e-health, e-learning and ICT (Igun 2013). Within a country, the digital divide can also be discerned between individuals with different incomes, educational, regional or racial statuses (Sacholeva, Kai & Sciomi 2015).

The digital divide gap also exists between physically challenged individuals and those who are not physically challenged. Studies on digital divide disability revealed that individuals with physical disabilities, such as functional blindness, are less likely to have computers, smart phones and internet connection at home than those without such disability (Kaye 2000; Dobransky & Hargittai 2006). Furthermore, ICT usage by people with physical impairments is more likely to be less than that of individuals without such impairments. The digital gap is even wider regarding physically challenged people who lack access to the internet at home and rely on community digital hubs. Furthermore, individuals who are physically challenged are not similar. They face various challenges related to their type of physical challenge, social status and income (Sacholeva et al 2015). If available, technologies such as cellular phones and the internet could be important resources to some physically challenged people and promote their inclusion in the digital society.

2.5 Forms of access related to the digital divide

Van Dijk (1999) distinguishes various forms of access that relate to the digital divide. Access to, and use of, ICTs is generally increasing but disparities in the use of ICTs exist. Van Dijk's multifaceted access model provides an understanding of the phenomenon.

2.5.1 Motivational access

The importance that an individual places on ICTs motivates them to acquire relevant technologies (van Dijk 2005). Individuals who are not motivated to acquire digital technologies are usually on the "wrong" side of the digital divide. It seems that it is not only the "have nots" that exist in society but also the "want nots" (van Dijk 2012). Some individuals are technology want nots, who have a dislike of computers and the internet. This could be due to the fact that they regard the content as irrelevant or do not believe that it is relevant (Cullen 2001). Mental factors such as technophobia and computer anxiety can also explain "the rise and fall of motivation" to access ICTs (van Dijk 2008:28). Research conducted in Europe indicates that technophobia, computer anxiety and distrust that usually accompany a new technology have however, decreased (van Dijk 2008).

It is further argued that individuals are motivated to obtain ICTs when there is also an increase in the availability of the technologies in a society (van Dijk 2012).

In the developed countries even persons above 80 are motivated to get access to the internet. For instance, 95 per cent of the Dutch population was motivated to have access to computers and the internet in 2011 (van Dijk 2012). It should, however, be noted that even in highly developed societies there are some individuals who refuse to get ICTs infrastructure. Some of the reasons for the refusal to get ICTs are inadequate money and insufficient skills.

Social and mental factors may also explain motivational access. It is posited that the main social explanation is that the low-income and low-educated individuals do not like the internet (Katz & Rice 2002). Research done in poor communities in the USA revealed that some individuals rejected computers and the internet because they believed that such technologies are for the working class (van Dijk 2012). Mental explanations postulated for a lack of motivational access are computer anxiety and technophobia. Fear, discomfort and stress experienced when using computers all explain computer anxiety (Brosnan 2002). Fear or dislike of technology is termed as technophobia. Computer anxiety and technophobia impede some people from accessing ICTs such as the computer, especially among the elderly and individuals with limited ICT skills. As already mentioned, these phenomena are decreasing, especially in industrialised nations, but it is not the case in most non-industrialised nations, especially in Sub-Saharan Africa.

2.5.2 Material access

Material access relates to having access to ICT hardware, software, applications, networks, and the degree to which ICTs can be used by individuals (Fuchs & Horak 2008; van Dijk 2008). Material access, thus, entails physical access to hardware and software (van Dijk 2005). Material access also includes peripheral equipment such as ink, paper, and subscription costs. A decrease in hardware costs might result in individuals purchasing more devices. Income is, thus, an important factor influencing access to ICTs. Internet connections and computers can be accessed at schools, home, and work and at public places. Van Dijk (2008), however, argues that there is a disparity to access conditions, access points and types of hardware. For instance, physical access to an advanced multimedia computer is different from access to a traditional personal computer. Another contrast relates to the type of network connection an individual is connected to. In the developed countries, the advertised speed for "entry-level fixed-broadband plan was 5 Mbit/s" compared to 1 Mbit/s in developing countries (ITU 2014). In addition to paying more for fixed-broadband, the customers in less developed countries, thus, get a slower connection than those in developed countries. Access to the internet is best summarised by Ndukwe (2010), cited in Tomei (2012) as having a right priced internet connection, at the right speed, and connected to appropriate content at an accessible place and relevant time. Thus, unequal access to ICTs is a result of uneven distribution of resources (van Dijk 2012). Uneven access to ICTs, consequently, leads to a social divide.

Furthermore, the devices that are used to connect to the internet, such as tablets and smart phones may indicate material divide. Mobile devices afford convenient and continuous internet access, compared to fixed home or workplace access to the internet (Mossberger, Tolbert & Hamilton 2012). Furthermore, devices complement one another. A laptop can be used for in-depth content searches and a smartphone for social interaction. Individuals with access to many devices have more opportunities compared to those with limited device access. The type and variety of devices to which an individual has access, thus, also play a role in providing material access. However, mobile devices do not allow for complex usage such as statistical analysis. People who only have access to mobile devices and not, for instance, computers, therefore use the internet only for social purposes and, at the most, elementary access to information (Hyde-Clark & Van Tonder 2011; Bornman 2012).

It is argued that age, income, educational level and other factors determine the amounts of ICTs that a person might have (van Dijk 2008). The physical access divides in developed countries started declining from 2002 due to an increase in the number of individuals with high incomes (Horrigan & Rainie 2002). However, material access gap in developing countries is widening and deepening, unlike in developing countries where it is narrowing (van Dijk 2005). Developing parts of the world, especially Sub-Saharan Africa, still have low literacy levels and unemployment rates are high, hence some people are unable to physically access ICTs.

2.5.3 Skills access

Digital skills are required for an individual to effectively use ICTs. Furthermore, the problem of skills, such as multimedia literacy and computer skills, might play a role in creating a digital divide. The concept digital skills was introduced by van Dijk (1999), and Steyaert (2002). Basic computer skills, termed operational skills, refer to the ability to manoeuvre with hardware and software (van Dijk 1999). Mastering computer skills is, however, not the only solution to skills problems. Scholars involved in the processing of information in a network society have posited that different kinds of digital skills are needed for the effective and efficient use of ICTs such as the internet. Informational skills are the skills required for searching, selecting, and processing information in computer networks. Strategic skills, on the other hand, are the capabilities to use ICTs for a specific goal and to improve a person’s position in society (van Dijk 2012).

Research conducted among Dutch citizens revealed that individuals with higher educational levels perform better on all skills than individuals with a lower educational background (van Deursen & van Dijk 2010). Age also plays a significant role on skills. Younger individuals have better medium-related skills than older individuals (van Dijk 2012). Furthermore, inadequate digital skills were found to be one of the limiting factors to the successful undertaking of online tasks. Disparities in individuals’ ability to transform their internet access and usage into positive offline outcomes is termed the third level digital divide (van Deursen & Helsper 2015). Individuals who possess information skills easily participate in cyberspace, they easily exchange information, are well linked and effectively networked (Castells 2004).

2.5.4 Usage access

The actual use of ICTs is the ultimate goal of ICT access (van Dijk 2005). Being motivated, accessing material and having digital skills are essential but inadequate conditions for actual use. The use of ICTs has its own determinants. These include the applications used, the use of broadband or narrowband, and the creative use of technology (van Dijk 2012). The implication is that closing the physical access gap does not necessarily mean that the usage gap closes in a society.

The usage time of ICTs differs in a society. The differences might be gender, age, income and education related. Research conducted in the Netherlands indicated that lowly educated people used the internet mainly for leisure, compared to highly educated people who used the internet for applications such as news, education and job-hunting (van Deursen & van Dijk 2010). Furthermore, diversity in usage applications was also observed by van Deursen and van Dijk among Dutch people. In Africa, most individuals with a tertiary qualification use the internet, whereas those with primary education hardly use the internet (Bornman 2012). It seems that individuals with low education used only a few applications, such as social networking, chatting and online gaming, but for a longer time than the highly educated individuals (van Deursen & van Dijk 2010). This implies that some parts of the population use the internet for applications such as education and work-related, while other segments use entertainment applications with no, or very little advantages (van Deursen & van Dijk 2014). Therefore, the time spend online does not necessarily reflect profitable use of the internet.

The digital divide is, therefore, multifaceted and has implications in three dimensions: a global divide, a social divide and a democratic divide (Norris 2001). These aspects are discussed in the following sections.

2.6 The global divide

The digital divide is prevailing in the world (International Labour Organisation 2001). It is one of the most serious problems in the 21st century, with developed countries enjoying high connectivity, while developing countries such as those in Sub-Saharan Africa have either limited connectivity or are disconnected. The global digital divide describes global inequalities, between industrialised and non-industrialised countries, with regard to access to ICTs and the opportunities of becoming part of the global information society. Disparities in accessing and using ICTs systematically places certain social groups in disadvantaged positions. The wealthy industrialised countries are heavily wired with ICTs, while the non-industrialised countries have poor ICT infrastructure.

Sub-Saharan Africa inhabitants of the region have a severe lack of ICTs skills (World Economic Forum Global Information and Communication Report 2012). In the same vein Burke (2012), and Wentrup, Strom and Nakamura (2016) argue that Africa's ICTs penetration rates and access numbers remain lower than those in other developing parts of the world. It is further elaborated that even the well-equipped facilities in Africa have less bandwidth than a home bandwidth user in Europe and North-America (Bornman 2012). Internet penetration rates are slow in the Sub-Saharan African region due to factors such as poor infrastructure, inappropriate technology policy and exorbitant prices.

Other challenges to ICTs access in Africa include poverty, which is often a consequence of unemployment and illiteracy (Mutula 2005). It can also be said that these challenges might result in low ICT adoption and use in Africa. The situation in Africa places her inhabitants in a disadvantaged position. The disconnected individuals are excluded from the information society. They are unable to access information that is important for their personal development, such as accessing educational opportunities, health information, participating on e-government platforms, and others.

Furthermore, some people residing in Africa are excluded from the global culture and the global economy (Dugarova & Gülasan 2017). Thus, developing countries are yet to attain measurable socio-economic benefits from ICTs. The scenario in Africa confirms Castells' (2003:247) view that the importance of ICT, including the internet, can be said to be "tantamount to marginality for those without, or with only limited, access to the internet, as well as of those unable to use it effectively”. With these challenges faced by some people in Africa, it is not surprising that the region, and in particular Sub-Saharan Africa, ranks lowest in Human Development Index.

There is also an uneven distribution of ICTs within the African continent (Gillwald & Stork 2008). Some countries, such as Eritrea, have very low ICTs penetration, whereas others, such as, Mauritius and South Africa, have been witnessing a growth in ICTs access and use among their citizens. It should be noted that South Africa previously led Africa in terms of internet and broadband. Recent statistics show, however, that South Africa has fallen behind countries such as Tunisia and Mauritius (Lesame 2013). There are also disparities in terms of accessing and using ICTs within the countries. South Africa, for instance, has deeper dimensions of inequalities which go beyond ICT access (Oyedemi 2012) and this will be discussed in the subsequent chapter. Members of the society who are disconnected are unable to benefit from the positive socio-economic consequences of the information society, such as improved quality of life, improvement in productivity and increase in employment opportunities (Bornman 2016).

The existence of unequal terms of trade has resulted in developing countries accruing debt (Fuchs & Horak 2008). The terms of trade deteriorated historically against developing countries because there have been dissimilarities in the growth of demand for primary goods and the manufacturing production. Developing countries, the main producers of primary goods, incur higher costs when buying manufactured goods from the industrialised countries. In this scenario, developing countries are disadvantaged in trading and will continue depending upon the developed countries, which will also continue making profit. Thus, dependency upon more advanced economies leads to the development of underdevelopment, which strengthens poverty, and restricts the existing resources for such nations to progress. These forces are still at work and they have an added aspect in that the rapidity of development and change when bound to ICTs is fast, making it hard for non-industrialised states to catch up

(Castells 2001). Furthermore, the digital divide symbolises Africa's position in the global economy and this digital divide is also an infrastructural reality (Kotecha 2010). There is no continent on the globe that epitomises and characterises the low-levels of socio-economic development more than Sub-Saharan Africa (Mutula 2005).

The global divide, thus, refers to the striking differences in the degree to which the industrialised countries and non-industrialised countries are benefitting from the adoption and usage of ICTs, and also the disparities in distribution of information technology, that is, the technological divide (James 2003). The global divide is, thus, also an economic divide. It concerns the dissimilarities in accessing and using ICTs between the wealthy and poor nations. The poor countries have little economic capital. Hence accessing ICTs and knowing how to use the ICTs is less likely among people in such countries. Dwellers of Less Developed Countries (LDCs) are in danger of being excluded in the information society.

Fuchs (2008) refers to the exclusion of certain groups of people and regions from the internet and the benefits that it involves as digital apartheid. Major barriers to internet dispersion are undependable infrastructure and exorbitant costs of internet services (Blackman 2002). These two, and other factors, such as low ICT skills, strengthen a vicious circle, leading to market failure. It is, however, possible to change "the vicious circle into a virtuous one" by setting up a dependable ICT infrastructure that can allow access to internet at low cost (Parker 2012). Some authorities are of the view that the presence of appropriate policy measures might narrow the global digital divide. Policy measures aimed at making networks accessible to the digitally marginalised people at affordable costs might lower the rate at which the global digital divide is widening (Billon, Rocio & Lera-Lopez 2009).

Furthermore, connectivity to the digital infrastructure is essential for economies to compete in a global market, as well as an educated and skilled labour force which can work in an e-economy (Wessels 2010). Therefore, countries that are disconnected from quality ICT infrastructure and have an unskilled labour force "are locked out of the global economy" and thus sink more and more into poverty (Ragnedda & Muschert 2013). The totally disconnected segments of the globe are categorised as "the fourth world" (Castells 1997) and Africa inhabits the largest part of it. According to Maggio, Celeste, Hargittai and Shafer (2004) the global divide stigmatises developing countries as it deters them from being part of modernity.

Opposing the view that ICTs enhance development are individuals bearing the marks of "Basic Needs Approach to development". These individuals argue that physiological needs such as clean water and food should come first before ICTs. The literature on ICTs is dominated either by the technophilic school of thought or the technophobic school of thought (Lesame & Seti 2014; Osiceanu 2015). The technophilic school of thought view the use of ICTs as yielding positive results in society. The technophiles believe that the economic and social situations in developing countries can be improved by adopting and using ICTs. Technological innovation in ICTs provides developing countries the opportunity to 'leapfrog' stages of development and catch up with the global information society (Nulens & Van Audenhove 1999; Sarrocco 2002). Adherents to this viewpoint believe that the adoption and use of ICTs might result in increased productivity and in the creation of employment.

On the other hand, according to the technophobic viewpoint, ICTs are believed to have negative consequences for society. The technophobic school of thought refers to ICTs as "engines of inequality", that give rise to the widening of the gap between information-rich and information-poor gap (Patterson & Wilson 2000). Concurring with Patterson and Wilson is van Dijk (1999), who argues that ICTs can cause a decrease in work opportunities, thereby increasing the gap between the rich and the poor. Furthermore, technophobes are of the view that ICTs negatively impact the development of society (Lesame & Seti 2014). They regard ICTs as a source of problems in society; they equate technology with dehumanisation and postulate that users of ICTs to be lost in cyberspace. ICTs are perceived as “imprisoning us in a technological cage”, thus reducing human life to “mere instrumentality” (Keller 2006).

The fact remains, however, that the internet is accessed more easily in the most developed countries (MDCs) compared to the least developed countries (LDCs). With the internet “at the heart of the new socio-technical pattern of organisation”, those in LCDs are “on the wrong side of the divide” and are not part of the internet dispensation (Thaver 2015:265). They, hence, remain underdeveloped. Disparities in internet access between developed and developing countries are evidenced by the International Telecommunications Union (ITU) (2015) global ICT statistics which indicate that only 34.1 per cent of households with internet access are in the developing countries, compared to 81. 3 per cent which are in the developed world. There has, however, been an immense growth in mobile subscription in non-industrialised parts of the world such as in Africa (Mamabolo 2017). However, the number of mobile subscribers in Africa is not commensurate with internet users. Africa still lags behind the rest of the world (ITU 2017). Hence, van Dijk (2006) argued that the digital divide gap in terms of accessing computers and the internet is growing in developing countries, whereas in developed nations it is closing. Inadequate ICTs limits a nation’s chances of providing solutions to other issues such as education, healthcare, housing and wealth creation, apart from the global divide.

2.7 The social divide

Inclusion and exclusion from the information society are digital divide dynamics related to the digital divide (van Dijk 2017). These dynamics articulate the levels of ICTs resources that individuals have access to. The social divide is another aspect of the digital divide which concerns the information haves and the information have-nots, not only in different parts and regions of the world, but also within societies. Information have-nots are, thus, not only found in non-industrialised countries, but also in industrialised countries (Norris 2001). Within the developing parts of the world, some segments of society are socially excluded, as some individuals are incapable of using services that are considered normal for a developed society (Chigona & Mbhele 2008). Social stratification such as geographical location, gender, age, family status and language result in different types of the social divide (Wilson 2006). Social stratification also relates to disparities in the extent to which individuals participate in the information society. Differences in the use of the internet may also be a consequence of cultural attitudes towards computer use. Some individuals are unfamiliar with English, yet many web pages are only available in this language. Thus, some individuals might avoid using the internet due to the predominance of a language which they do not understand. Another important social factor influencing the use of ICTs in some developing countries is the low social status of some women (Khan, Hasan & Clement 2012). Women are the primary caretakers of families and children. Thus, even if they have access to ICTs, they may find little or no time at all to use technologies due to being overburdened with household chores. Men, on the other hand, disproportionately occupy, for instance, academic and technical roles, which provide easier access to ICTs, such as the internet.

Some authorities also argue that differences in ICT capability globally create inequalities that go beyond the structure of the present societal inequalities (Ho & Tseng 2006). The already socially disadvantaged individuals are the first ones to be excluded from the opportunities associated with the emergence of an information society (Radu 2012). For instance, post-industrial societies require a skilled labour force which can work as knowledge workers and can change knowledge into action (Castells 2001). Some individuals do not have the required digital skills and resources to participate effectively in the job market.

Furthermore, segments of society with high educational levels also tend to have high income levels and they can access ICTs and the internet both at their workplaces and at home. Such individuals also use the internet more efficiently and to greater economic benefit, for instance, market information and job opportunities, than their less advantaged but still connected peers (Ibrahim 2009). The knowledge gap therefore, tends to grow rather than shrink.

Some parts of the developing countries, especially rural and remote areas, are less connected. Irrelevant content and non-existent technological support are other obstacles to the use of the internet in least developed societies (Chen & Wellman 2005). The digital divide is, therefore, another form of social exclusion in communities where obstacles to accessing ICTs are similar to barriers to accessing other necessities such as education, health, employment opportunities, and/or services and facilities (De Haan & Rijken 2002). Thus rural and remote parts of a society might be becoming more marginalised at the edge of communication networks.

Governments should ensure that all citizens have convenient opportunities for ICTs. Some rural dwellers "travel long distances to access ICTs at multi-purpose community centres" in small towns (Chisango 2014:38), whereas in urban areas, people easily access technologies at work, home, libraries and Thusong service centres. A Thusong Service Centre is a community centre which provides access to ICTs such as the computer, the internet, faxing and telephone services (Thusong Service Centre [sa]). Individuals located in remote areas may require public programmes to widen and deepen their inclusion into the information society. Some analysts, however, argue that though improving accessibility to ICTs and the internet are important in society, assumptions should not be made that only these can solve problems associated with the digital divide within and between countries (Kubicek 2004).

2.8 The democratic divide

The democratic divide refers to the dissimilarities between those who utilise the digital technologies, the internet in particular, extensively to play a part in public life, and those who do not do so (Norris 2001; Kassam, Iding & Hogenbirk 2013). The democratic divide implies that some individuals are politically marginalised in the information society due to, for instance, limited ICT skills and lack of internet connection, among others.

Some scholars regard the internet as a "democracy-promoting medium", which bonds individuals to one another regardless of geographical location and creates public spheres. According to the cyber-optimists perspective, the internet allows individuals to be involved in direct democracy (Norris 2001). The internet strengthens connections between citizens and political parties, news media, political officials, and others. Individuals can also participate in political initiatives, such as voting online, discussing politics, as well as signing electronic petitions.

However, if the internet is only used by certain individuals in a society, then its "democratic potential" is seriously undermined (Min 2010). Thus, the cyber-pessimists postulate that ICTs, mainly the internet, reinforce deeper divisions between the information-rich and information-poor (Norris 2001). It is further elaborated that the democratic divide reinforces "the activism of the activists"; it facilitates the involvement of individuals who have already an interest in politics (Norris 2001). Those individuals who are not engaged in politics might remain behind. The democratic divide, thus, implies that "non-electronic voices" are politically marginalised in the information society (Shelley, Thrane & Shulman 2006:48).

Access to ICTs, internet skills and motivation to adopt and use ICTs are important for individuals to meaningfully engage in democratic processes, since ICTs are now widely used in political communication (Wessels 2010). Socio-economic and demographic factors, such as educational level, gender and age, are regarded as factors that determine the differences in internet usage for politics. Individuals with higher educational and income levels are more likely to actively use the internet for political purposes than the poor with low educational levels. An individual's online behaviour partly reflects their online skills (Hargittai 2002, 2005). Individuals without appropriate skills and are unfamiliar with the internet, would find it difficult, if not impossible, to participate in digital political initiatives.

People who are highly interested in politics are more likely to take part in online public activities, thus growing their scope of political influence. Therefore, differences in internet skills and political interest may create a democratic divide. People develop digital skills and participate in democratic process at different levels, due to unequal levels of digital opportunities (Garnham 2005).

2.9 Conclusions

Nations recognise the importance of ICTs in the information and knowledge society, as much as they recognise the fact that inequality in the distribution and sharing of ICTs and accessing information also exist (Avgerou & Madon 2005). Inequalities in accessing and using ICTs have, however, resulted in digital divide becoming part of the information society discourse (Askonas & Stewart 2000; Molina 2003 & Warschauer 2004). As earlier on alluded to, the information society and the digital divide provide context for this study. The existence of the digital divide in society means that the adoption and use of ICTs in teaching and learning will be a challenging undertaking. The role of ICTs in the development of societies, including institutions of learning, has thus led many to ponder the consequences of inequitable access to them. Therefore, the next chapter focuses on the position of Africa - and more specifically South Africa - in the information society and the digital divide.

CHAPTER 3

THE INFORMATION SOCIETY, THE DIGITAL DIVIDE AND AFRICA WITH SPECIFIC REFERENCE TO SOUTH AFRICA

3.1 Introduction

The previous chapter involved discussions on the information society and the digital divide. The focus of this chapter is the position of Africa, and more specifically South Africa, in the information society and the digital divide. In the previous chapter it has emerged that the information society is not spread equally - a situation that has given rise to different forms of a digital divide. Africa is widely regarded as one of the least developed continents (United Nations Conference on Trade and Development 2017). Africa is also the least developed with regard to its integration with the information society. This chapter, thus, specifically focuses on discussing inequality in developing countries in Africa, and more specifically South Africa, where this study is situated.

3.2 An analysis of the information society and the digital divide in Africa

Global connectivity is rapidly growing, but the digital divide between the most developed countries (MDCs) and least developed countries (LDCs) is widening (International Telecommunication Union (ITU) 2017). A large part of the population of the LDCs is, consequently, in danger of being left out of the information society. Differences in the amount of information individuals' access create inequality in society, at national, regional and global levels. As explained in the previous chapter, these inequalities give rise to the "information-haves and information-have-nots" (Bornman 2016). The digital divide, thus, mirrors the relationship between the internet and the societal disparities such as accessibility issues, digital skills, affordability and civic engagement (Blackman 2002). A consequence is that the people of a least developed continent such as Africa are less able to benefit from the development potential provided by ICTs due to factors such as poor infrastructure and exorbitant access costs. Information and communication services costs are, furthermore, high in most African countries compared to the rest of the world (Bornman 2012). However, it is argued that the "marriage of mobile phones and internet" could bring new opportunities for networked communication for people (Bornman 2016). Some analysts have voiced the hope that mobile phones and the internet will bridge the gap between the connected and the disconnected because there is an increase in mobile phone ownership across the globe (Broadband Commission 2013). There are, however, concerns that mobile internet largely enables the social functions of ICTs and not higher order activities such as information and strategic functions (Hyde-Clark & van Tonder 2011).

In an information society, large percentages of individuals are linked to communication and information networks, such as the internet (Nath 2009). This is not, however, necessarily true in Sub-Saharan Africa where the large sections of the population are disconnected from the internet (ITU 2013; ITU 2017). As mentioned in the previous chapter, unequal access to, and use of, ICTs creates a digital divide at societal, national and continental levels (Fuchs 2008). The literature suggests, however, that ICTs have the potential to alleviate poverty in poor countries and help these societies to "leapfrog" stages of development (van Audenhove 2003). These technologies, for example the internet, are also important tools for societal integration because they can enhance greater access to information about, for instance, health, e-government and farming (Oyewumi 2006; Demombynes & Thegeya 2012; Asongu 2015). It is, thus, important to determine the state of the information society and digital divide and their implications for Africa, and South Africa in particular.

3.2.1 Access to fixed-line telephones

For most people in the developing countries, especially in Sub-Saharan Africa, making a telephone call is still a remote possibility, though we are in the era of wireless and satellite communication (Mutume 2003).

Table 3. 1: Access to fixed- line telephone

Fixed-telephone subscriptions per 100 inhabitants, 2008-2017										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Developed Countries	44.3	45.5	44.6	43.4	42.2	41.3	40.2	39.0	38.1	37.3
World	18.5	18.4	17.8	17.2	16.7	6.0	15.1	14.3	13.6	13.0
Developing Countries	12.8	12.4	11.9	11.5	11.2	10.6	9.9	9.2	8.5	8.0
Least developed countries	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9

Source: International Telecommunications Union, 2017.

From the data in Table 3.1 it can be deduced that a fixed-line telephone divide exists between the most developed countries and the developing countries. Fixed-line telephone penetration rates in developed countries are four times higher than in developing countries as indicated (ITU 2017). Expensive telephone charges further characterise most of Africa's telecommunications facilities (Mutume 2003). The costs of fixed-line telephones are lower in the developed world and are at an average cost of 1.0 per cent of GNI per capita, compared to 5.2 per cent in the developing countries (ITU 2014).

Table 3.1 further indicates a decline in the fixed-telephone subscription rate in both developing and developed countries. The reason postulated for the decline in the number of fixed-telephone subscriptions is the growth in mobile phones subscriptions (ITU 2017). The total number of the fixed-telephone subscriptions has fallen from 1.26 billion in 2006 to an estimated 972 million in 2017 (ITU 2017). However, the low level of fixed-telephones in developing countries has persisted since before the introduction of mobile phones, reflecting historically low-levels of infrastructure deployment (ITU 2017). Various reasons are posited for the shrinking number of fixed-line telephone in the developing countries. Governments incur high upfront capital costs in rolling out new wired infrastructure and maintaining the infrastructure is also costly hence the low fixed-line telephone penetration rates. Vandalism of copper cables has been alluded to as another cause of the decline of fixed-line telephone services in some African countries. Copper cable theft is also reported in South Africa (van Zyl 2013).

The fixed-line telephone is also facing stiff competition from mobile phone (Gillwald, Moyo & Stork 2012; Van Zyl 2013). Individuals who do not have fixed-line telephones opt for a mobile phone, which has more advantages than a fixed-line telephone. Mobile phone operators offer both post-paid and prepaid services to consumers. Furthermore, smart phones have applications which enable users to access information and communicate from anywhere. Therefore, the growing consumer demand for wireless smart phones in comparison with fixed-line telephones has a negative impact on the growth of the fixed-line telephone market segment. The fixed-line telephone networks have been mostly used to provide fixed broadband access to, for instance, businesses and also homes (Shizha & Diallo 2016). It is, consequently, a problem that countries in Sub-Saharan Africa have limited availability of fixed-line telephone networks (Williams 2010). Limited broadband access, thus, could have negative effects on the growth of an economy. Broadband is, thus, recognised as an enabler of economic development (The Commonwealth Telecommunications Organisation 2012). It is estimated, for example, that a 10 per cent increase in broadband penetration in low- and middle-income countries can result in a 1.38 per cent increase in economic growth (Barnes 2015).

It is, therefore, argued that increased institutional and infrastructural investments are needed to stimulate the development of a more robust fixed broadband infrastructure (Shizha & Diallo 2016). Such investments include ICT infrastructure such as submarine cables, regional networks, national backbones, and also policy and regulatory reforms that better balance the needs of business and consumers.

3.2.2 Access to the internet

The internet directly impacts the socio-economic and political environment in Africa (Bahrini & Qaffas 2019). Improving access within countries will also enable more individuals to access the internet from personal devices such as tablets, smartphones and also from community centres. Furthermore, broadband internet is positively changing the lives of people in non-industrialised countries. It aids accessibility to economic opportunities that were previously unreachable to the poor people (ITU 2012). For instance, financial inclusion of people through mobile phones in Africa has been facilitated by mobile broadband (ITU 2012).

There has been an expansion in wireless networks and in submarine fibre-optic cables linking Africa to the world (Williams, Mayer & Minges 2011). This is due to the realisation that technology is an important aspect of wealth creation (Skaletsky, Soremekun & Galliers 2014). The internet has a positive impact on trade and commerce. ICTs have made the creation of a global marketplace possible. With the presence of the internet, distance is no longer a barrier to entry into international markets. Furthermore, small and medium enterprises can also participate on global markets, giving rise to new prospects of economic growth, electronic trade, investment and commerce (Sarrocco 2002).

Broadband access has both a “direct and indirect economic impact”, which is explained by Katz (2012:13). He explains that the installation of broadband infrastructure leads to the creation of employment, which presents a direct benefit to society. It also holds indirect benefits such “as a result of spill-over externalities”, for example, improved production of goods (Katz 2012:19). It is estimated that for every 10 per cent increase in broadband penetration, there would be 1.38 per cent increase in the economic growth in developing countries (Kim, Kelly & Raja 2010).

Although the social, economic and political benefits of the internet are recognised, not every individual in the world is connected to the internet. Research revealed that an estimation of above 3.5 billion persons would be internet users in 2017, representing 48.0 per cent of the world population (ITU 2017). Ninety per cent of the individuals who are disconnected from the internet dwell in the non-industrialised countries, especially in Sub-Saharan Africa (ITU 2014). A majority of the world population is still excluded from the information society (Negroponte 1995). The access gap is even widening in some developing countries (van Dijk 2012).

To further exemplify the digital divide between the developing countries and the developed countries are the ITU global ICT statistics on household internet (ITU 2017). There are 42.9 per cent households with internet access in the developing countries, compared to 84.4 per cent which are in the developed world (ITU 2017). Only 18.0 per cent of households in Africa had home internet, in comparison with the global average of 53.6 per cent (ITU 2017), with South Africa at 9.5 per cent. Internet penetration in Africa reached 18 per cent, with 216 million internet users (Business Day Ghana 2017). These statistics show that that there is an extreme digital divide between the developing and developed countries. Inadequate ICTs limit a nation's chances of providing solutions to other issues such as education, healthcare and housing.

Furthermore, the World Economic Forum Global Information and Communication Report (2012) states that the Sub-Saharan Africa region does not only have the least developed ICTs infrastructure, but the people of Africa also have limited digital skills. The African region has the lowest ICT Development Index, and South Africa has, for example, an IDI value of only 4.96 (ITU 2017). Countries with higher IDIs are in the developed world. Iceland, with an IDI of 8.98, was ranked the highest globally (ITU 2017). The top IDI countries in Africa, such as Mauritius and Seychelles, are, however, continuing to make good progress in ICT development, while the least connected fail to keep pace both within the region and at global level, (Ragnedda & Muschert 2013) and this implies digital divide within Sub-Saharan Africa.

With these ITU statistics, it can be said that the United Nation's Open Working Group (OWG) on sustainable development goals recommendation that the global community should try hard to supply universal and affordable accessibility to the internet in least developed countries (LDCs) by 2020, seems to be too optimistic. Factors such as exorbitant costs, low bandwidth in national "backbone networks and fixed line access networks" hamper internet access growth in Sub-Saharan Africa (Foster & Briceno-Garmendia 2010). Lack of internet access, for instance, has deprived many Africans of the opportunity to take advantage of health services, e-learning and online financial services. For the developing countries to close the access gap, two issues should be addressed, the key ICT infrastructure and conditions of usage. Key ICT infrastructure includes aspects such as electricity, mobile and internet coverage. Conditions of usage include those that influence access, such as the ICT price basket and digital literacy.

3.2.3 Fixed broadband costs

The availability of broadband internet accelerates social and economic growth in the contemporary world (Organisation for Economic Cooperation and Development (OECD) 2008). It enables and facilitates economic and social services, for instance e-government and education (Bold & Davidson 2012). A broadband digital divide already also exists between Africa and the rest of the world (Igun 2013). The African region has the most expensive fixed-broadband prices, making internet access even less accessible due the low gross national income (GNI) levels on the continent (ITU 2014). Africa's people are, thus, unable to enjoy broadband benefits due to, among others, high costs and poor infrastructure. The affordability target set by the Broadband Commission for 2015 was that the fixed-broadband prices would have to cost less than 5 per cent of the GNI per capita. In some developing countries, the price of broadband, however, exceeded average monthly income (ITU 2012). High prices and irregular electricity supply, among others, are, therefore, a barrier to telecommunications service in most African countries. Exorbitant prices might be a result of a lack of competition in African markets. Furthermore, incumbent network operators in Africa have less extensive networks than in other regions, and are usually not the main providers of backbone network services. In contrast, in other regions, large-scale investment in backbone networks has resulted in competition, thereby encouraging entry into the market (Williams 2010).

3.2.4 Access to mobile phones

The mobile phone revolution took Africa by storm (Gillwald 2008). Subscriptions grow by 2.000 per cent in a decade. There are currently 960 million mobile subscriptions in Africa, which is an 80 percent penetration rate among the continent's population (Business Day Ghana 2017). Africa took to mobile phones so fast because fixed landlines were few and mainly available in urban areas. Mobile phones are almost the most economical and fastest way of communicating when fixed-lines are underdeveloped and/or unavailable.

Mobile communications offer many opportunities to advance human and economic development (The World Bank 2012). For instance, the proliferation of mobile phone networks has changed communications in Sub-Saharan Africa (Cell phones in Africa …2015). The mobile revolution is not only associated with the provision of communication but can be used to transfer and receive money, thus offering access to financial services, among other things (Demombynes & Thegeya 2012). Some individuals based in the rural and remote areas of Africa cannot easily access the banks, but with the increased access to mobile phones on the continent, those individuals can now access financial services on their mobile phones (Asongu 2015). Accessing financial services on the mobile phone is also cheaper and it is a cost-effective way of including people to financial services.

Oyewumi (2006) gives examples of how the mobile revolution has solved issues of access on the African continent. He posits that the availability of market information on mobile phones allows rural farmers to compare prices of inputs and decide when and where to sell their produce. Equal access to market information might mean that farmers will no longer consult third parties whom they pay to market and transport their produce, and this might also result in fairer transactions. It was, for example, found in Senegal that information available through the use of mobile phones enabled farmers to double the prices of their crops (Fong 2009). Such benefits of using ICTs may be translated into the economic growth of a country.

It is projected that Sub-Saharan Africa will have 500 million mobile phone subscribers by 2020 (The mobile economy Sub-Saharan Africa 2017). Mobile phone manufacturers such as Huawei and Infinix provide a greater choice of devices at a wider range of prices.

Some authors, however, warn that high mobile penetration rates in Africa could be an over-calculation, since some markets are characterised by multi-SIM use (Calandro, Gillwald, Moyo and Stork 2010). Mobile operators deal with SIM cards when approximating the number of their customers. SIM cards are, however, not always a precise representation for the number of customers, especially in the African context, as multiple SIM cards is a common phenomenon (ITU 2017). Some individuals use multiple SIM cards, others are multiple device owners and some are inactive users of the mobile phones, hence the total connections figures reported by operators might be distorted.

Despite the mobile revolution and its merits in Africa, the continent is, nevertheless, the region with the lowest rate of subscribers to mobile phones (ITU 2017). It is only Africa which had less than 100 mobile subscribers per 100 inhabitants amongst other ITU regions such as Europe and The Americas (ITU 2017). Some of the reasons why many people in Africa lack a mobile phone include: Africa is the second largest continent, some of its inhabitants are scattered in farms, rural and remote areas. Furthermore, powering phone masts in remote areas is difficult to maintain and telecommunications companies use diesel generators which are regularly refuelled and are, therefore, expensive (Reshef 2018). Calls and data are transmitted from the broader networks. Therefore, the telecommunications companies spend a lot of money laying cables or buying bandwidth on satellites to transmit the calls and data (Mobile phones are transforming Africa 2016). Similarly, The Global Information Technology Report (2015) argues that the cost of rolling out ICT infrastructure in rural areas is higher due to lower population density and is, thus, a challenge to telecommunications operators. Also, the mobile networks provide poor quality services in many African countries. It is often difficult for some customers to connect calls and sometimes their calls are disconnected prematurely (Adegoke, Babalola & Balogun 2008).

Furthermore, the mobile price basket is expensive in some developing countries, such as South Africa, as indicated by the table below (OECD 2012). Mobile price sub-basket refers to the price of 30 outgoing calls and 100 SMS messages per month (ITU 2015). The mobile price basket is calculated as a percentage of a country's average monthly gross national income (GNI) per capita (p.c.) and is presented in USD (ITU 2015).

Table 3. 2: The Organisation for Economic Co-operation and Development (OECD) mobile baskets

Table: OECD Low User Basket costs in USD					
Country name	Cheapest product				
	dominant operator		Cheapest in country		% cheaper than dominant
	Rank	US$	Rank	US$	
Mauritius	1	2.39	5	2.39	Dominant is the cheaper
Ethiopia	2	2.61	7	2.61	n/a
Namibia	3	2.74	8	2.74	Dominant is the cheaper
Kenya	4	2.85	1	1.90	33.4%
Egypt	5	2.91	9	2.91	Dominant is the cheaper
Sudan	6	3.53	6	2.46	30.5%
Ghana	7	3.87	11	3.28	15.1%
Libya	8	3.90	14	3.90	Dominant is cheapest
Rwanda	9	4.28	3	2.16	49.4%
Guinea	10	4.62	2	1.93	58.1%
Sierra Leone	11	5.04	13	3.88	23.1%
Uganda	12	5.51	10	2.94	46.6%
Congo Brazzaville	13	5.63	17	5.63	Dominant is cheapest
Tanzania	14	5.82	12	3.75	35.7%

Algeria	15	.621	4	2.28	63.3%
Tunisia	16	7.24	18	6.46	10.9%
Senegal	17	8.11	24	8.11	Dominant is cheapest
Botswana	18	8.16	20	7.66	6.0%
Sao Tome &Principe	19	8.21	25	8.21	Dominant is cheapest
Nigeria	20	8.40	16	5.22	37.8%
Madagascar	21	8.45	27	8.45	Dominant is cheapest
Mali	22	8.78	29	8.78	Dominant is cheapest
Burkina Faso	23	8.88	28	8.53	4.0%
Benin	24	9.10	22	7.92	13.0%
Mozambique 25 10,00 33 10,00	25	10.00	33	10.00	Dominant is cheapest
Chad	26	10.14	34	10.14	Dominant is cheapest
D.R. Congo	27	10.37	19	7.62	26.5%
Côte d'Ivoire	28	10.41	36	10.41	Dominant is cheapest
Cameroon	29	10.44	35	10.28	1.5%
South Africa	**30**	**11.07**	**32**	**9.83**	**11.2%**
Togo	31	11.18	38	11.18	Dominant is cheapest
Zambia	32	12.05	26	8.22	31.8%
Niger	33	12.30	31	9.77	20.6%
Central African Republic	34	12.33	39	12.33	Dominant is cheapest

Source: OECD mobile basket, 2012.

From Table 3.2, it can be deduced that South Africa performs badly in comparison to most African countries. In comparison to the rest of Africa, the lowest priced product in South Africa is five times more expensive than the cheapest product in Africa (Research ICT Africa 2015). The cheapest product offered by Mauritius's dominant operator costs USD 2.39 compared to the cheapest product offered by South Africa's dominant operator, which is USD11.07 (Research ICT Africa 2015).

Most countries which allow competition in their markets have low-user packages that are cheaper than the dominant operator's cheapest low-user package. For instance, the state-owned operators in Uganda, Tanzania and Rwanda are the cheapest in the country. Tanzania Telecommunications Company Limited (TTLC) is the cheapest operator and its prices are far lower than those of the dominant operators, Vodacom and Airtel (Research ICT Africa 2012). Ethiopia's single state owned operator also charges low prices. However, it is argued that the low mobile price basket in Ethiopia does not generate surplus money to invest in the extension of the network. Thus, Ethiopia has the lowest mobile penetration rate in Africa and network services are mainly available in urban areas (Research ICT Africa 2012).

Furthermore, 350 million people across the globe live out of reach of a mobile signal (ITU 2015), hence the digital divide is still deepening even despite the spread of mobile cellular phones. In developing countries, such as in Sub-Saharan Africa, a huge divide exists between the well-connected urban areas and poorly connected rural and remote areas (Curry, Dumu & Koczberski 2016). Finally, most mobile phones used by individuals in developing countries are of an older generation. They do not have features and applications required to access information online. The ICT revolution requires modern technologies such as smart-phones connected on high-speed internet connection (Global Information Technology Report 2015).

3.2.5 Mobile broadband

Internet adoption and use was initially accessed by means of desktop computers at workplaces, public access points and institutions of learning, but this has changed with the advent of the mobile phone (Hlagala 2015). Currently the internet is accessible by means of mobile phones in Africa.

The literature suggests that internet usage via mobile phones in Africa will increase twenty fold in the next five years (The Guardian 2014), and some analysts believe that developing countries are progressing well (Wentrup, Strom & Nakamura 2016). Those who concur with this argument believe that there is hope of connecting people to the internet and that mobile broadband is the main enabler in assisting nations to leapfrog stages of development and experience benefits of the information society (Castells 2001; ITU 2011). Furthermore, the availability of mobile internet does not only solve ICT infrastructure problems, but it is believed that it will also play a paramount role in enhancing ICT skills in Africa (ITU 2011). It is further explained by Bornman (2012), that many Africans already use mobile phones, implying that they have some basic ICT skills which enable them to use the internet. Researchers who are sceptic of Africa's progress in the information society believe that African nations still need to improve in the area of broadband, data and internet, to move forward in the information technology era. Reinforcing the view that Africa still needs to improve internet access to its inhabitants are ICT statistics on the internet penetration rate in the world. The lowest internet penetration rate is in Africa (ITU 2014). Out of 3.46 billion mobile-broadband subscribers in the entire world, only 162 million people residing in Africa subscribe to mobile broadband (ITU and UNESCO 2015). It should be noted that the number of mobile-broadband subscribers was, however, expected to reach an estimate of 4.22 billion globally by end of 2017 (ITU 2017).

The costs of the mobile-cellular sub-basket remain high in the least developing countries, with services costing more than 5 per cent of Gross National Income (GNI) per capita (ITU 2017). The mobile-cellular sub-basket is one of the three tariffs sets (sub-baskets) which make up the ITU's ICT Price Basket (IPB) (ITU 2011). The other two sub-baskets are the fixed telephone and fixed broadband internet services. The GNI, on the other hand, refers to all the income earned by a country's residents and businesses. The GNI per capita is, therefore, the total value of goods and services in a country divided by the number of people living there (ITU 2014). South Africa stood at 5.490 per cent of GNI per capita by 2016, performing worse than her neighbour Botswana, which was at 6.750 in the same year (The World Bank 2016). South Africa's mobile-cellular price sub-basket is, thus, expensive, making it difficult for many individuals to use all cellular phone services. Differences in ICT prices create a digital divide among countries within the same region.

The cheapest pre-paid mobile cellular plans can be found in other developing countries, such as in Sri Lanka, whose pre-paid mobile-cellular price was USD 0.95 per month compared to South Africa at USD 20.40 by 2013 (ITU 2014). Most countries with the least affordable mobile cellular services are found in Africa. One of the reasons for unaffordable mobile cellular services in Sub-Saharan Africa is that some African governments allow monopolisation of the market (Fuchs & Horak 2008). Unaffordable mobile-cellular services are an obstacle to further adoption of ICTs among the poor people in many African countries. Prices may be brought down through a competitive approach and this might assist in reaching the low income users. Competition among firms results in the service providers lowering prices of the products that they offer. Thus, low-income individuals might be able to afford mobile cellular services. Competition also forces the ICTs service providers to improve the quality of products that they offer to consumers (The World Bank 2016).

In the developing world 500 megabytes of handset-based broadband data on a monthly plan are eight times more expensive than in developed countries (ITU 2014). A huge difference in the affordability and availability of the two services between Africa and other regions explains a low mobile broadband penetration rate in Africa. Furthermore, African operators offer low-volume bundles which last for about two days and this limits internet usage. However, Bornman (2012) opposes this view. She argues that the availability of small amounts of prepaid data might lower the income barrier because low income individuals can buy data and access the internet whenever there is money to do so. Affordable high speed internet should be made accessible to all people for them to be able to enjoy the socio-economic and political benefits of having an internet connection. Otherwise the majority of the African population will continue being out of the internet dispensation.

Accessing affordable ICTs is important in an information society. However, it can be argued that information literacy is a vital skill set that people need for effective functioning in an information society. Knowing when information is required, confidence in using ICT tools available to, for example, modify and evaluate, as well as to disseminate that information, is termed information literacy (Julien 2016).

3.2.6 Literacy levels

In our rapidly changing technological society, it is important for individuals to learn the new digital skills in order to effectively participate in the local and global social community (Stromquist 2005, cited in UNESCO 2006). The definition of literacy is, therefore, no longer only understood as:

> A set of reading, writing and counting skills, but as a means of identification, understanding, interpretation, creation, and communication in an increasingly digital, text-mediated, information-rich and fast-changing world (UNESCO 2017).

Literacy is vital for securing meaningful access to political, economic and cultural opportunities in society. For instance, literate individuals are usually those who participate in politics, hence contributing to the quality of public policies and democracy (UNESCO 2006). Individuals with effective literacy skills have more access to educational and employment opportunities, which enable people to pull themselves out of poverty and unemployment. Literacy also enables improved family health and nutrition, while literate individuals have the ability to understand and interpret health information. From the highlighted importance of literacy, it can be said that literacy is the key to sustainable development (UNESCO 2017).

Literacy levels in the African region are, however, relatively low. Mason (2011) is of the view that even if the “last mile” problem in Africa is overcome, Africa’s ability to use the internet effectively is questionable since the continent is knowledge poor. The “last mile” refers to ICTs providing connection services to and from the user’s home or office (Holmner & Britz 2013). It is posited that some individuals in Africa are not connected to digital technologies, hence the existence of the “last mile" problem in the continent (Narayan 2007). The adult literacy rate in Sub-Saharan Africa was 65 per cent in comparison with the global adult literacy rate which was 86 per cent in 2016 (UNESCO Institute for Statistics 2017). There is an increase in the youth literacy rates in Sub-Saharan Africa. However, they are still lower than that of developed countries (Holmner & Britz 2013). The youth literacy rate in Sub-Saharan Africa was, for example, 75 per cent in comparison with the global youth literacy rate of 91 per cent (UNESCO Institute for Statistics 2017).

The level of adult and youth illiteracy in Africa forms a "mirage of literacy", it is not a true reflection of the intellectual ability of individuals to assign meaning to the information they access (United Nations 2008). The ability to synthesise accessed information is needed. A lack of digital skills coupled with poor quality primary education, consequently leads to failure in developing human intellectual capacity in most African nations. This makes it difficult for Sub-Saharan African countries to participate and compete as equal partners in the global knowledge economy (Holmner & Britz 2013).

Literacy is affected by the quality of education. Research conducted in five West and North African countries revealed that more than half of primary school learners were not acquiring required competencies in the economy (Easton & Moussa 2019). Required competencies include reading, writing and computer skills. In the South African context, predominantly Black poor schools are unable to equip learners with essential literacy and numeracy skills (Spaull 2015). Echoing the same sentiments is Modisaotsile (2012) who argues that South African schools continue producing poor Grade 12 results. Low levels of content among some teachers and inadequate resources contribute towards poor quality education in South Africa (Spaull 2015). Skills deficiencies among schools that poorly perform are, therefore, most likely to persist.

Furthermore, the fact that African countries have poor access to the internet and other ICT resources has far reaching implications for education (Kotecha 2010).

Academics and students at institutions of learning with limited access to the internet, thus, find it difficult to access local and global knowledge.

3.2.7 The language of the internet

The language used on the internet forms another barrier to usage access (Pearce & Ronald 2014). It is tough to connect the unconnected due to the language barrier among individuals in some countries. Though website pages are now also in other languages, such as German and Japanese, English has been the dominant language used on the internet. English is regarded as the language of the internet and approximately 85 per cent of information stored on the World Wide Web is in English (Coşkun 2017).

Van Dijk (2008) states that three quarters of the global population does not know English and this prevents the global diffusion of digital information. Confirming van Dijk's argument are Ono and Zavodny's (2008) study in the United States of America, which revealed that the gap between the Hispanics and white non-Hispanics in ICTs increased though there was an increase in the computer and internet use among the Hispanics. The gap was due to differences in English language ability. Hispanic families which only spoke Spanish indicated lower internet usage.

3.2.8 Socio-cultural factors

People of different gender experience different challenges in their use of ICTs (Stoilescu & McDougall 2011). Women often do not have adequate financial resources, have lower educational levels, and lack equal opportunities to access ICTs (The South African Institute of International Affairs (SAIIA) 2017). The gender digital gap is, thus, perpetuated by social and economic barriers, such as illiteracy and cultural gender roles.

Chang, Shieh, Liu and Yu (2012) pointed out that working women have better chances of accessing ICTs than housewives. Chang et al further argued that working women tend to actively use ICTs in different environments, such as at home and in public places. Housewives on the other hand seldom have the opportunity to use ICTs. Thus, they might experience anxiety when learning how to use ICTs, such as computers. Also, women in urban and rural areas in the global south are 50 per cent less likely to access the internet than their male counterparts (SAIIA 2017).

Research conducted in the United Arab Emirates (UAE) indicated that gender relations informed the use of ICTs, such as the internet (Mohamed & Joanna 2017). More men in UAE used the internet more to communicate with people outside kinship than women did. Men did not mind women communicating on social media platforms, such as Twitter, with family and friends. However, a few men supported women who used social media platforms to participate in public forums and express themselves. The use of media platforms was regarded as too liberal and against culture (Mohamed & Joanna 2017).

Statistics revealed by ITU (2016) indicated that internet penetration rates for men were higher than for women in all regions. For example, in Africa, it is only 21.9 per cent of women who can access the internet, compared to 28.4 per cent males who have access to the infrastructure (ITU 2016). High costs hamper billions of people from getting connected to the internet (SAIIA 2017). Women earn almost 25 per cent less than men globally, and are more likely to be highly impacted by high connectivity costs (World Wide Web Foundation 2016).

It is further postulated that males and females differ in their use of ICTs such as computers, and also in self-efficacy. Research conducted by Durndell & Haag (2002) revealed that male students performed better in computer courses than females. Durndell and Haag further posited that male students scored higher in computer self-efficacy, had lower anxiety, and had more positive attitudes towards internet usage. Male students were also more confident in ICTs use than female students. However, it is argued that African-American females were more likely to effectively and meaningfully use ICTs when compared to their African-American males (Jackson, Zhao, Kolenic, Fitzgerald, Harold, & Von Eye 2008, cited in Ritzhaupt, Liu, Dawson & Barron 2013).

Studies conducted in Taiwan revealed that elderly women acknowledged the importance of ICT skills, but lacked confidence to use technology such as computers, and feared breaking the computers (Lin, Tang & Kuo 2007). Some elderly women lack support from family members, and rather, are made to feel anxious. That tends to increase their negative attitudes towards ICTs.

3.2.9 Fibre-optic networks

It is only recently that Africa has been connected to submarine fibre-optic infrastructure that provides large bandwidth (Williams 2010). Williams further argues that the submarine fibre-optic infrastructure is also important for the provision of affordable broadband services, otherwise the region was largely disconnected from the global submarine cable networks. Initiatives to connect Africa to the rest of the world include the Africa Coast to Europe (ACE), SEACOM and the West Africa Cable System (WACS). The WACS, for instance, is an ultra-high capacity submarine cable system (MTN Nigeria 2018). The WACS links Europe, West Africa and South Africa. These undersea cables offer Africa new connectivity and increased access to international broadband network at a lower cost.

However, rural areas in Africa remain largely unconnected to the internet since they struggle to attract investment (ITU 2015). Broadband access in Sub-Saharan Africa is, therefore, more concentrated in urban areas than in rural and remote parts (Williams 2010). Fibre-optic networks are mainly in urban areas where individuals with higher incomes reside and also many businesses are located. This creates demand for ICT services. Therefore, individuals who reside in urban areas have more access to broadband than those in rural and remote parts of the region. It is also argued that the limited growth of broadband in Sub-Saharan Africa is a result of the inadequate domestic backbone. The domestic backbone network infrastructure in Sub-Saharan Africa is characterised by low-capacity networks usually owned and operated by operators focusing mainly on voice services (Williams 2010). The incumbent network operators have less extensive networks and usually are not major service providers of backbone network services. It is argued that exorbitant cost of network construction, operation and regulatory restrictions are the underlying causes of this pattern of network and market development in Sub-Saharan Africa (Williams 2010).

Furthermore, many residents of Africa only have access to low speed internet, compared to those in the developed world. Research revealed that Egypt has more bandwidth than Sub-Saharan Africa (Williams 2010). The lack of international bandwidth in Africa is one of the main reasons for poor quality broadband internet experienced by most of users in the region. Internet connection is usually slow and getting a connection is also a problem, especially in rural and remote areas.

3.2.10 Electricity supply

Another obstacle hindering the growth of broadband access especially in rural Sub-Saharan Africa, is insufficient electrification infrastructure (Mangeni, Hamdounm, Ennser and Mubiru 2013). ICTs, such as computers and mobile phones, consume electricity directly supplied by the electric grid, including batteries of portable devices that are to be recharged from the grid as well (Souchon, Flipo, Aebischer and Roturier 2007). Access to information through, for instance the internet and mobile phones is impossible if there is no reliable electricity supply.

Electricity supply in Sub-Saharan African countries is characterised by various challenges, including frequent power cuts, inadequate capacity to meet the rising demand, and high costs (USD 0.5/kWh) (World Bank 2008). Research further revealed that about 609 million people in Sub-Saharan Africa had no access to electricity, and an estimated 530 million people will not have access due to population growth by 2040 (The World Bank 2017).

3.2.11 Possible solutions to differences in access to broadband internet

It is crucial that the entire African region gets connected to the global submarine cable networks. Submarine fibre-optic infrastructure provides a high bandwidth, low cost alternative to satellite for carrying traffic to, and from, the African region.

The development of the submarine fibre-optic infrastructure is, thus, important for the provision of affordable broadband services (Polishuk 2006). Submarine fibre optic cables are needed to connect countries to the global internet. For instance, South Africa is connected to the rest of the world through five submarine cables, which include Seaco, SAT-3 and WACS (How South Africa is connected to the global Internet 2014).

Satellites, in addition, play an important role in the access network (telephony and data) since their wide coverage provides a simple low cost solution. Satellite is used to deliver both the international bandwidth to internet service providers (ISPs), and in the access of network from ISPs to customers (The Commonwealth Telecommunications Organisation 2012). Satellites can also provide mobile communication if terrestrial mobile communication is unavailable.

The use of both satellite and fibre-optic infrastructure is, thus, important in Africa as argued by the Commonwealth Telecommunications Organisation (CTO). The CTO acknowledges the growth of fibre-optic submarine cables in Africa, but posits that despite that growth, 40 per cent of Sub-Saharan Africa might not be able to access broadband services. The key constraining factors on broadband access in Africa are price and a limited supply. It is still crucial that Sub-Saharan Africa uses satellites as a complementary technology. Satellites play an important role in delivering cost effective broadband access to people (Barnley 2012). Any location can be connected via satellite bandwidth in Africa, but this is not so with submarine cables networks.

Regulatory measures that encourage infrastructure sharing and universal service policies can be implemented and help in expanding broadband to under-serviced areas (Garcia & Kelly 2016). Governments in Sub-Saharan Africa can expand telecentres in all the under-serviced rural and urban areas as a measure of mitigating the unavailability of telecommunications services and internet connectivity. Multi-purpose telecentres are technology-based community centres that offer services such as computers, the internet, printing, and e-mail to individuals in rural and other disadvantaged areas (Colle & Roman 1999).

It is also suggested that infrastructure sharing policies can be implemented by the governments in Africa. The governments can promote telecommunication power sharing to expand the “last mile” network coverage in rural and remote areas. High costs of providing broadband in rural and remote areas, where demand is low, can be reduced by sharing fibre networks (Unlocking broadband for all 2015). Infrastructure sharing can assist service providers in reducing the cost of building, operating and maintaining infrastructure (Ncube, Charles & Lufumpa 2017). In rural areas, governments could support infrastructure sharing and mutualisation as a way of reducing the negative effects of the economies of density. Economies of density occur when a higher number of users in a geographic area lowers the costs for providing services. Armstrong and Fuhr (1993) suggest infrastructure mutualisation strategy as a way of reducing the effects of economies of density. Infrastructure mutualisation is also a way of avoiding unnecessary network duplication by erecting shared infrastructure in areas that are less profitable. In rural and remote areas, demand is lower and costs of network deployment are higher. Infrastructure sharing can assist in expanding broadband coverage to rural areas (Unlocking broadband for all 2015). Infrastructure sharing and mutualisation also make the market contestable, thereby reducing barriers to market entry, monopoly rents and exit barriers (Garcia & Kelly 2016).

3.3 An analysis of the information society and digital divide in South Africa

South Africa occupies 1 219 090 square kilometres and has a total population of 54. 96 million people, of which 26.89 million are male and 28.07 million are female (South Africa 2016). The country consists of two-worlds in one, according to authors such as Aliber, Kirstein, Maharajih, Nhlapo-Hlope & Nkoane (2006). Van Biljon (2016) concurs that South Africa has characteristics of both developing and developed economies. The majority of the population, 87 per cent, forms the second economy, while 13 per cent, comprise the first economy, which is viewed as the creator of employment for the second economy (Aliber et al 2006). The greatest part of wealth in South Africa is produced by the first economy which is also integrated within the global economy. On the other hand, the second economy contributes relatively little to the gross domestic product (GDP), contains a large percentage of the South African population, includes the poorest of urban, rural and remote population, and is disconnected from both the first and the global economy (Infrastructuration 2007). The majority of the South African population forms part of the second economy. It is therefore, plausible to argue that the country is an unequal society characterised by wide differences between the wealthy and the poor (Oyedemi 2012).

Moreover, research done by the World Bank (2011) reveals that although the country is a middle income economy, it is still an unequal society, and one of the areas of disparity is the digital divide. Sikhakhane, Lubbe and Klopper's (2005) study reveals that individuals in South African urban areas have relatively good access to resources such as computers, libraries and the internet, unlike in rural parts of the country where accessibility to these resources is limited. People living in the rural areas and poor pockets of some urban areas have, however, restricted access to ICTs because of poor infrastructure and low incomes. Most people in rural South Africa travel long distances to access ICTs resources in small towns (Chisango 2014).

People who are living in rural and remote areas are unable to tap into the global store of knowledge due to the unavailability of ICTs infrastructure, such as the internet. The information society is limited in some rural and remotest parts of South Africa because these areas and populations are not well integrated into the information society (Deji 2012). The remotest areas of the country are most likely to be left out of the information society due to the digital divide.

The limited ICT infrastructure is also a challenge for anyone wanting to provide internet and other ICT services in rural areas in South Africa (Gillwald et al 2012). There are very low fixed telephone-line penetration rates in rural areas. Fixed telephone lines which were once in some parts of rural South Africa were disconnected by the incumbent, Telkom (Horwitz & Currie 2007). Fixed telephone lines were disconnected due to non-payment and poor billing mechanisms of

Telkom. The few remaining fixed telephone-lines cannot adequately address the needs for data applications, hence a continuing digital divide between rural and urban South Africa (Conradie & Jacobs 2003). Therefore, Castells (2001) argues that different levels of accessibility to, and usage of, digital technology services marginalises the disconnected individuals from the global village.

Progress in integrating the society into the information society is evident in South Africa, but the country still needs to do more in order to become a fully-fledged information society (Bornman 2016). ICT policy makers are concerned that improvement in ICT infrastructure is slow and illiteracy levels are high, and these negatively impact on the advancement towards becoming an information society (Lesame 2013). The government of South Africa has, however, made laudable efforts to expand accessibility to ICTs and to market government services through technology, especially in rural areas. This has taken the form of, for instance, Thusong Service Centres (TSC) and also cyber-laboratories at some schools (Abrahams 2011; Vivier, Seabe, Wentzel & Sanchez 2015).

3.4 Governmental initiatives to address challenges related to ICT access and use in South Africa

South Africa participated in the World Summit on the Information Society (WSIS), in both the Geneva and Tunis phases in 2003 and 2005 (ITU 2006). Both WSIS summits enjoin nations to develop national e-strategies that would guide transformation towards an information society. The development of the National Information Society and Development (ISAD) plan of the South African government is in keeping with this requirement. South Africa has taken various steps to provide its citizens access to information and access to ICT infrastructure. The Universal Service and Access Agency of South Africa (USAASA) was established with a mandate of ensuring universal service and access to ICT infrastructure for all citizens. Initially, the South African government proposed models for achieving universal access that were focused on accessing a working telephone. However, this strategy later changed with the advent of the technological age, where information is attained and distributed through various channels. Accessing a telephone within a walking distance is not sufficient for the effective and efficient participation of individuals in the information society (Collins 1996). The universal access concept was, thus, expanded to include access to a computer, the internet and a telephone.

Furthermore, the National Planning Commission (NPC) was established in May 2010, to identify challenges which hinder socio-economic growth in South Africa (The National Planning Commission 2014). The NPC advises the government on issues that influence the long term development of South Africa. For instance, the country should have a strong network of economic infrastructure, which includes ICTs and transport. ICT is an important enabler of economic activity in an information society. ICTs provide networks for communication and information flow that increase productivity and efficiency (The National Planning Commission [sa]). It is, thus, paramount that the national ICT structures effectively address the needs of the nation.

Liberalising telecommunications markets presents an attempt to enhance access to ICTs. Previously, the telecommunications sector in South Africa was monopolised by Telkom, which was granted a five year regulated monopoly in 1997 to extend telecommunications services in South Africa (Hodge 2000). The government's attitude towards the telecommunications sector, however, changed. The sector is now open to competition. Market liberalisation has reduced the cost of telecommunications, resulting in an overall decline in the cost of doing business. However, Fuchs and Horak's (2008) study on digital inequalities in South Africa found that market liberalisation could not succeed in narrowing the digital divide, primarily due to immense inequalities in income levels as well as educational and digital skills barriers. Although South Africa has a high adult literacy rate, some of its citizens are functionally illiterate (see section 3.5.2). The functionally illiterate individuals have limited digital skills and find it difficult to use ICTs. Also, South Africa has two economies as earlier on alluded to. Individuals who belong to the first economy have better incomes than those who belong to the second economy. The literate individuals with high income levels are better placed to own and use ICTs than individuals with low and/or no income at all.

It can be argued that though the ICT sector in South Africa is growing, the country has not yet provided affordable universal access to ICTs to all of its citizens. Hence, the governmental initiatives to address challenges related to accessibility and usage of ICTs in South Africa include the establishment of Multi-purpose community centres (MPCC), setting-up cyber laboratories at schools, Batho Pele Gateway Portal and Telecentres.

3.4.1 Multi-purpose community centres (MPCCs)

Community access to ICTs plays a major role in rural and remote areas with low levels of household internet access (ITU 2014). The South African government adopted the Telecommunications Policy in 1996, aimed “at promoting equal access to telecommunication services or universal service” to these services, regardless of an individual’s geographical location (Lesame, Mbatha & Sindane 2011:206). This led to the establishment of multi-purpose community centres (MPCCs) in disadvantaged communities in South Africa. Multi-purpose community centres (MPCCs), now rebranded as Thusong centres, provide public access places to services such as the internet, the telephone, fax machines and photocopying (Thusong [sa]). The establishment of these centres is an attempt to compensate for the low penetration of ICT infrastructure in rural areas and townships. The MPCCs are shared by local communities in rural and disadvantaged urban areas.

As some rural areas in South Africa are far from urban centres and it is expensive to travel to urban areas, MPCCs have been established in small rural towns (Thusong service centre 2000). The MPCCs provide communities with services such as information regarding weather forecast, educational opportunities, health issues, market prices and farm practices. Thus, these centres facilitate information sharing, and reduce the marginalisation experienced by rural societies. The MPCCs provide a means of dialogue between rural communities, townships and the government departments and also facilitate distance education. People are able to access the internet and conduct research for their studies at the MPCCs. At MPCCs, individuals pay for the ICT facilities and services that they use. It is more affordable paying a fee at the MPCCs than purchasing ICT tools (Gyamfi 2005). The availability of MPCCs in rural areas and townships eliminates barriers that prevent some individuals from using ICTs. The MPCCs, thus, facilitate access to the internet so that the technological gap between the urban and rural areas is minimised.

Some authorities argue that the availability of MPCCs in rural South Africa does not necessarily close the rural-urban digital divide (Sikhakhane 2005). Chisango (2014) has, for example, found that there is only one MPCC in the Intsika-Yethu local municipality in the Eastern Cape Province. This implies that the MPCCs available in communities are not adequate for the surrounding population, who might have to take turns to use the computers and other services. The time that people can use a computer could, consequently, be limited (Oyedemi 2012). Failure to connect all citizens and equip them with relevant skills results in a non-inclusive information society.

3.4.2 Batho Pele Gateway Portal

The advent of the concept of e-government has resulted in African governments gradually changing the way in which they communicate with their citizens (Singh & Travica 2018). Previously, communication used to be via the radio, television, public gatherings and the print media. This has now changed or is changing to communication through ICTs such as the internet and mobile phones (Kroukamp 2005). In South Africa, the government has a web portal named the "Batho Pele Gateway", which provides access to government information and services through the use of ICTs (Department of Public Service and Administration 1997). The Batho Pele (People First) project was initiated in 2004 and, its principles include creating a customer oriented mind-set in the South African public service.

Furthermore, to counter language barriers regarding access to the internet, the contents of the portal is translated into all of South Africa's eleven official languages, enhancing access to information among individuals who are not acquainted with English. This initiative is strengthened by the Government Communication and Information System (GCIS). The GCIS provides an informational portal on services provided by the government. Government services such as e-filling, which facilitates electronic submission of tax returns, can be accessed in this way (Kroukamp 2005). However, the participation of the South African population is stifled by low ICT infrastructure dispersion in rural and remote parts of the country. Bagchi, Udo & Kirs's (2007) study documents that South Africa has low levels of internet adoption due to inadequate ICT infrastructure and functional illiteracy. The South African government should, thus, strive to improve the accessibility, affordability and availability of ICTs to citizens and also improve the literate rate levels in the country.

3.4.3 Internet access at schools

The ITU (2014), states that schools are an important internet access point in rural and township schools. The South African government, for instance, rolled out broadband to 500 schools in rural, disadvantaged communities through the Dinaledi school project (ITWeb 2008). The Dinaledi project is the initiative of the Department of Communications, the Department of Education, and the Department of Trade and Industry. A Dinaledi school is identified as a school with African learners as the majority and has a minimum of 50 students doing Mathematics in the higher grade (ITWeb 2008). The project provides broadband access to rural and township schools which were previously disconnected from the internet. Internet connectivity is essential for every student and teacher, regardless of geographical location. The availability of computers and internet connection at schools enables digitally competent teachers to access current information about the subject content that they teach. The use of technology also enhances independent learning among computer literate students.

Access to the digital technologies is, however, limited to learners and educators during specific hours. It should also be noted that some rural schools are not even connected to the internet, have inadequate ICT infrastructure, and ICT accessibility is a challenge (Lundall & Howell 2008; Chisango 2014). Limited access to ICTs thwarts the commitment made by world leaders at the 2007 WSIS to "turn the digital divide into a digital opportunity for all" (ITU 2006:3). It is postulated that making ICTs accessible to all students does not necessarily make education equitable (Braverman 2016). It is only providing learners with learning resources, such as computers and internet connection that they individually require which makes digital education equitable. It is also believed that if internet is made available to all people, it warrants an inclusive information society, regardless of an individual's status in society. This view is, however, criticised by van Dijk (2012) who states that in addition to connectivity, the digital divide is also about how those accessing the internet make use of it.

3.4.4 Other government initiatives to provide ICT access

Local and provincial governments are also engaged in the implementation of various ICT projects in efforts to provide access to ICTs to the public, for instance, the Smart Cape Project in the Western Cape Province (Naidoo 2012) and the free TshWi-Fi powered by the City of Tshwane (City of Tshwane 2015). The City's Smart Cape Project is a far-reaching Smart City initiative of the local government, which provides access to free internet to people in Cape Town (Western Cape Government 2007). The City's e-governance strategy also helps in developing ICT skills among local people. The city of Tshwane provides a free Wi-Fi service, across more than 780 TshWi-Fi internet zones in Tshwane. The TshWi-Fi internet zones include open public spaces, educational institutions, clinics and libraries. Users can access 500 megabytes free data, make free calls and free movie streaming (City of Tshwane 2015). Individuals who were formerly disconnected from the internet due to the high costs of broadband can now be part of the information society due to the availability of the TshWi-Fi in the city of Tshwane.

Having mentioned some of the government initiatives to address challenges related to ICTs access and use in South Africa, it is important to measure South Africa as an information society.

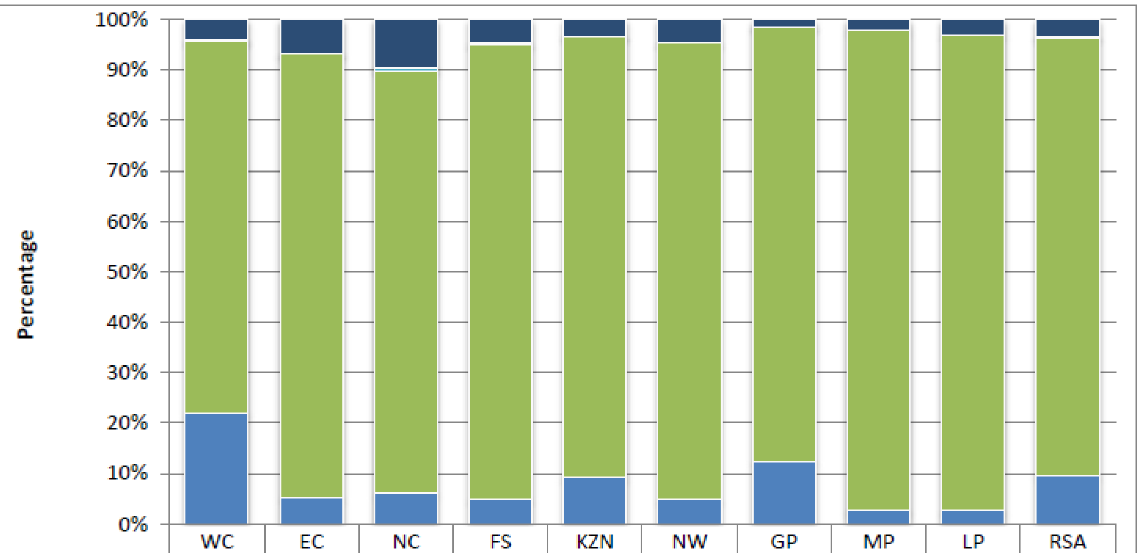
3.5 Measurements of the information society: an analysis of South Africa

The ITU's ICT Development Index (IDU), an index used to measure the information society, is divided into the following sub-indices, "access sub-index, use sub-index and the skills sub-index" (ITU 2015:11).

3.5.1 Information and communication technology access sub-index

The information and communication technology access sub-index includes five infrastructure and access indicators (ITU 2015). These are fixed-line telephone subscriptions, mobile cellular subscriptions, households with internet access, households with a computer and international internet bandwidth per internet user.

Figure 3. 1: Percentage of households who have a functional landline and cellular telephone in their dwellings by province in South Africa, 2018.



	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
None	4,2	6,9	9,7	4,7	3,3	4,6	1,5	2,3	3,1	3,5
Only landline	0,2	0,1	0,5	0,2	0,2	0,1	0,1	0,0	0,0	0,1
Only cell	73,6	87,8	83,8	90,2	87,4	90,5	85,9	95,0	94,4	87,0
Cell & landline	22,0	5,3	6,0	4,9	9,2	4,8	12,5	2,7	2,6	9,4

Source: General household survey, 2016

It can be deduced from Figure 3.1, that 87.0 per cent of households in South Africa owned a mobile phone (South Africa: General household survey 2016). Ownership of a fixed-telephone line was limited, with only 0.1 per cent of household owning only a landline. A few households had access to both mobile phones and fixed-telephone lines. Some households did not own either a mobile phone or a landline. A detailed discussion of the relevant issues with regards to ICT access sub-index will be made in more depth in the sections that follow.

Fixed telephone ownership

Table 3. 3: Households with access to a functional landline by province, 2018

	Thousands									
Ownership of a landline phone	**WC**	**EC**	**NC**	**FS**	**KZN**	**NW**	**GP**	**MP**	**LP**	**SA**
Yes	346	71	22	47	211	42	377	30	30	1 176
No	519	1 582	318	838	2 664	1 161	4 420	1 246	1 529	15 277
Unspecified	12	32	*	16	29	6	57	14	20	218
Total	1 877	1 685	342	901	2 905	1 210	4 884	1 289	1 579	16 671

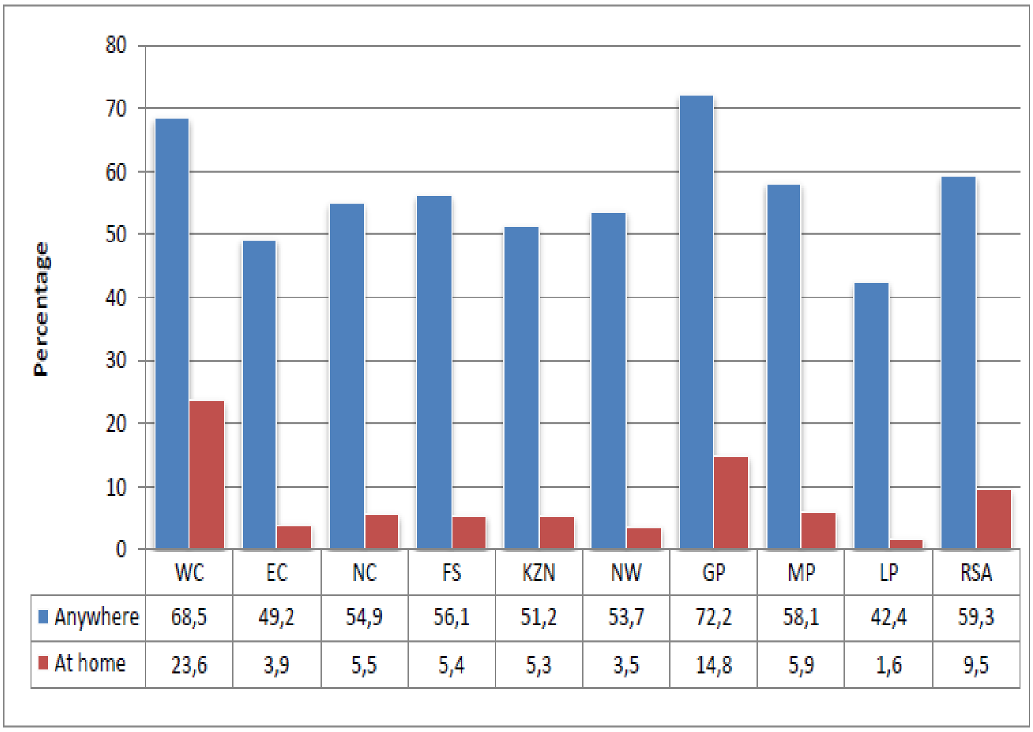
Source: General household survey, 2018

Table 3.3 shows that 1 176 000 households in South Africa owned a fixed landline telephone by 2018. The Western Cape had the largest number of households (346 000) with access to fixed-line telephones. The total number of households in the Western Cape (494 336) is, however, lower than the total number of households in Gauteng (715 671) (General household survey 2013). Though there are more households in Gauteng than in the Western Cape, only 377 thousand households had access to a fixed-line telephone in Gauteng. The smallest number of connected households was found in Northern Cape, which had 22 000 households with fixed-line telephone access.

High ICT costs and infrastructure disparities in the country explain the differences in ownership of fixed-line telephones (Oyedemi 2009). Legislation was passed in 1996 to roll out telephone services throughout the country. Telkom was given the mandate to expand services to the formerly disconnected communities. Telkom’s mandate was to roll out 1.7 million lines in underserviced areas, connect 3.204 villages to the telecommunication network, build 1.67 million lines and install 120. 000 payphones (Oyedemi 2009). This exercise was futile because many households, especially in rural areas, had to be disconnected again by Telkom due to the non-payment of the high tariffs which were charged by the incumbent (Horwitz & Currie 2007). Unaffordable telecommunication services, therefore, demotivates individuals, especially the low-income groups from using the services (Chisango & Lesame 2017). Hence, there is lower fixed telephone penetration rates in rural South Africa than in urban areas.

Access to the internet at home

Figure 3. 2: Percentage of households with access to the internet at home, or for which at least one member has access to or used the internet by province, 2016



Source: General household survey, 2016

Figure 3.2 shows that more access to home internet is enjoyed by metropolitan households, such as those in the Western Cape and Gauteng, than by rural households such as those in Limpopo and Eastern Cape (South Africa: General household survey 2016). This physical access gap is perpetuated by the unequal distribution of ICT infrastructure in the country and unaffordable fixed-broadband services. There is, thus, limited access to the internet networks and other ICTs which the South African National Planning Commission (NPC) argues that they are core to economic recovery strategies (Lesame 2013). Obstacles to internet access at home include low computer literacy among the lowly educated individuals, poor infrastructure, especially in rural areas, and high costs of the internet services (Sikhakhane 2005; Chisango & Lesame 2017).

Oyedemi's (2012) study exemplifies the inequalities in home internet access in South Africa among university students in South Africa. His research findings reveal that only 16.3 per cent of students living in rural areas have access to the internet at home, compared to 60.9 per cent of those living in urban areas. As a result, students from rural and other disadvantaged communities rely on accessing the internet on campus. Most provinces which are largely rural, such as the Eastern Cape, have the highest levels of poverty, hence some of the dwellers cannot afford getting an internet connection at home.

It should, however, be noted that though Figure 3.2 indicates that more urban households have access to home internet than rural households, the digital divide also exists among urban dwellers (Molawa 2009). The highly educated and those in affluent suburbs have more access to ICTs at home, compared to those in poor townships who cannot afford having technologies, such as the internet at home. There is, therefore, a need to address issues of access to affordable ICTs in South Africa.

Mobile phone ownership

The mobile revolution is said to have assisted in addressing the intense inadequate availability of ICT infrastructure in some African countries (The World Bank 2011). South Africa has a total of 15 107 000 households, and 87.0 per cent of the households owned a mobile phone by 2016 and that translated to 13 143 090 households (South Africa: General household survey 2016). This high level of cellular phone ownership has enhanced universal access to ICTs to a limited extent and failed to reduce the digital exclusion, which further exacerbates the lack of digital skills which are needed in the country (Lesame 2013). Not every household owned a mobile phone in South Africa, as indicated by the General household statistics. Individuals who have access to ICTs gradually develop digital skills through the constant use of these technologies (Drotner & Livingstone 2008). Mobile phone ownership was the highest in metropolitan cities and the lowest in largely rural provinces. The difficult terrain features of land, which include large rivers and mountainous areas, and the non-existent electricity grid in some remote areas are other hindrances to the building of mobile phone networks in some rural areas (Dobermann 2016). Furthermore, some remote rural areas are not connected to the electricity grid due to the high costs of the installation of electricity, whilst areas that are connected to electricity often experience power cuts (Off-grid rural electrification 'pivotal for SA economy' 2015). In 2016, 84.2 per cent of households in South Africa were connected to electricity supply (General household survey 2016). The remaining 15.8 per cent South African households which were unconnected to electricity might find it difficult, if not impossible, to own and use any ICT devices.

Furthermore, the mobile phone price basket is expensive for some individuals, especially the low income segment of the population who survive on social grants of about R400 per month (Research ICT Africa 2016). Making a mobile phone call is also expensive in South Africa. Individuals pay between 75c and R2.80 per minute, with data varying between 3c and R2 per megabyte, depending on the operator and package selected by an individual (ITWeb 2015). Research conducted by Research ICT Africa (2016) in the rural Nyandeni local municipality in the Eastern Cape revealed that it is expensive to communicate on mobile phones. Residents of Nyandeni spent 22 per cent of their disposable income to a very limited basket of services (including only 7 SMS and 77 minutes of calling time a month - a week) (Research ICT Africa 2016). Similar findings are reported for the rural Emalahleni local municipality in the Eastern Cape, where some individuals do not even have a mobile phone handset since they cannot afford buying one (Chisango 2014). By international standards, South Africans pay more for mobile phone price basket and it is, thus, not surprising that there are only 46.7 mobile-broadband subscribers per 100 inhabitants in SA (ITU and UNESCO 2015). Hence the ITU and UNESCO ranked South Africa 69 out of 165 economies.

Access to mobile broadband

If made available, broadband enhances accessibility to economic opportunities and social welfare that could otherwise not be accessed by the poor (ITU 2012). Therefore, the South African government ensures that citizens, regardless of their geographic location, can connect to a fast, reliable, and affordable ICT infrastructure. Many people are getting connected to broadband on mobile phones, routers and modems. The costs of purchasing the equipment are lower (Research ICT Africa & Intelecon 2012).

The adoption and use of broadband in South Africa is, however, limited by several factors, such as cost of access and the cost of data (Chetty, Sundaresan, Muckaden, Feamster and Callandro 2013). The price of mobile broadband is equivalent to “10 per cent of household expenditure for 70 per cent of residents” (ITU 2014). Therefore, only 30 per cent of the population of South Africa may have enough money to subscribe to a cellular phone broadband for household members. Exorbitant prices charged by service providers are a barrier to mobile broadband access. For instance, uncapped internet plans are highly priced, and many customers use capped plans as low as 10 MB for mobile access (Chetty et al 2013).

Furthermore, research done in South Africa indicates that many consumers experience low speed broadband, yet they pay a lot for internet (Chetty et al 2013). Unaffordable broadband is associated with, for example, limited access to health services, reduced access to open distance learning, limited participation in government processes, and an increase in the digital divide (Department of Communications 2010).

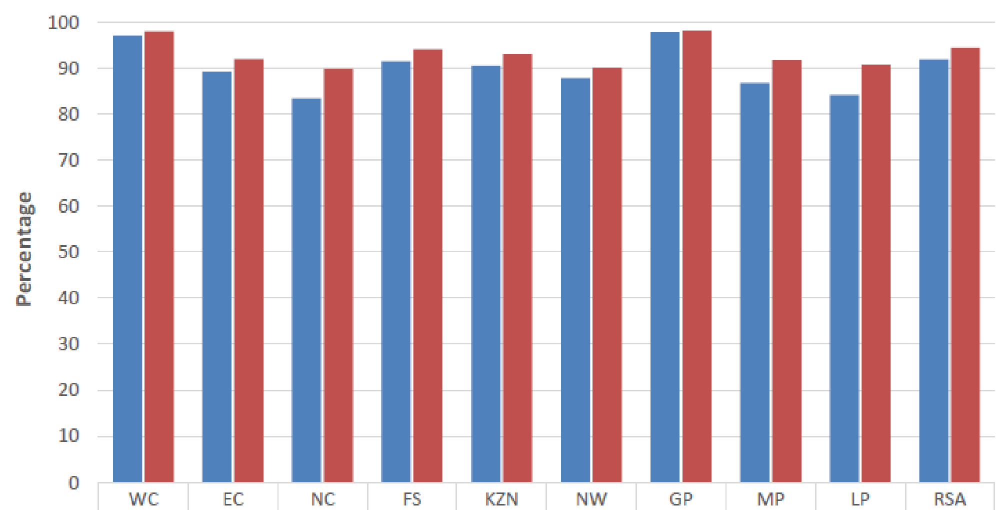
Growth in South Africa's ICT sector, especially the mobile phone uptake, has not led to the reduction in costs and the universal access to communication services. South Africa used to be the continental leader as far as internet and broadband connectivity are concerned, but has lost that status (Esselaar, Gillwald, Moyo & Naidoo 2010). Barriers to expanded use of mobile phones and fixed-line telephones include exorbitant prices of services and limited competition among service providers (The National Planning Commission [sa]).

3.5.2 Information and communication technology skills sub-index

Basic literacy is a necessity for an individual to use ICTs (Wagner & Kozma 2005). The ICT skills sub-index comprises the adult literacy rate, gross secondary enrolment and gross tertiary enrolment.

Adult literacy rate

Figure 3. 3: Adult literacy rates for persons aged 20 years and older by province, 2010–2016



	WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
2010	97,0	89,2	83,4	91,5	90,5	87,8	97,8	86,7	84,1	91,9
2016	98,0	91,9	89,8	94,0	93,0	90,1	98,1	91,7	90,7	94,4

Source: General household survey 2016.

South Africa had a high adult literacy rate which was 94.4 per cent in 2016, with the major cities topping the literacy rate in the country (General household survey

2016). However, some of South Africa's citizens are functionally illiterate, that is 14.6 per cent of persons aged 20 years and above (General household survey 2016). Functional illiteracy refers to a person's inability to read, write, and calculate (Vágvölgyi, Coldea, Dresler, Schrader and Nuerk 2016). The functionally illiterate and those with limited digital skills find it difficult to use the computer and the internet. Unequal accessibility to, and usage of, technology such as the computers and the internet is a digital divide phenomenon which needs to be addressed in the country if inclusion is to be achieved (Fuchs and Horak 2008). Different literacy levels in South Africa show that the country is not yet an information society.

Gross secondary school enrolment

A country's gross secondary school enrolment is also used to measure the skills-sub index (IDI 2017). Schools in urban provinces had a higher enrolment compared to rural schools, and this could be a result of higher population density in urban areas (Education statistics in South Africa 2015). It is in rural provinces where low secondary school completion rates were recorded, for instance, rural provinces such as the EC was at 44.3 per cent and Limpopo at 39.2 per cent in 2016, while urban provinces such as the GP had completion rates of 72.4 and the WC at 65.4 per cent in the same year (Statistics South Africa 2016).

Furthermore, results from the General Household Survey (GHS) Release (2016) indicated that the number of persons who did not have any schooling declined from 10.6 per cent in 2002 to 4.9 per cent in 2016. Rural provinces recorded the highest percentage of individuals without any schooling, with Limpopo topping the list at 9.2 per cent, while in Mpumalanga 8.0 per cent of the population did not go to school. Urban provinces had the lowest percentage of persons with no schooling at all, GP and the Western Cape were at 1.5 per cent and 2.1 per cent respectively (General Household Survey Release 2016). A decrease in the percentage of individuals without any schooling also meant a decrease in the functionally illiterate persons in South Africa. The percentage of functionally illiterate persons aged above 20 years decreased from 27.3 in 2002 to 14.6 per cent in 2016. This can be attributed to increased accessibility to schooling. Thus, it can be concluded that the literacy rate in South Africa is gradually increasing.

Gross tertiary enrolment

Gross tertiary enrolment is another measure of the skills sub-index (ITU 2015). The gross tertiary enrolment is affected by the secondary school completion rate. A higher secondary completion rate might also imply higher tertiary enrolment. The secondary school completion rate in the South African context refers to the proportion of persons aged 20 to 24 years of age who had finished Grade Twelve (South African Millennium Development Goals 2013). Enrolment at higher institutions of learning increased from 4.0 per cent in 2002 to 4.5 per cent by 2016. The rate at which enrolment in higher education increased between 2002 and 2016 was, however, very low. There were about 766 812 students enrolled at higher educational institutions during 2016. This low higher education enrolment can be attributed to low secondary school completion rates, which stood at 55.1 per cent in 2016 (Statistics South Africa 2016).

Relatively low secondary and tertiary enrolment rates have social and economic implications in the country. It is at higher institutions of learning where students are imparted with skills needed in society. Low enrolment rates might result in the under-supply of skilled labour force, such as technical and vocational workers (Grossen, Grobler & Lacante 2017). Individuals who do not obtain some form of post-secondary qualification are at an economic disadvantage. They might struggle to find employment, and can be unemployed for continued periods of time, if not permanently (Weybright, Caldwell, Xie, Wegner & Smith 2017). Unemployment leads to poverty, which in turn can result in social ills such as crime. It is argued that the health of a person is predicated by education (Weybright et al 2017). Individuals who do not enrol for secondary and tertiary education might suffer from “poorer psychological, physical, social, and economic health” (Lamb & Markussen 2011, cited in Weybright et al 2017:1).

The information society and the digital divide in South Africa have far-reaching consequences as discussed in the previous chapter.

3.6 Implications of the digital divide

The uneven distribution of ICTs access in Sub-Saharan African countries may mean that segments of the population who have no or limited accessibility to ICTs may be denied socio-economic and political opportunities (UN Report on the World Social Situation 2016). Such opportunities include e-democracy and e-learning. The adoption and use of ICTs can, for instance, increase democratisation, facilitating the participation of citizens in decision-making processes of the government through electronic channels. A digital gap in a country increases the cost of public engagement since governments will interact and communicate with citizens through, for instance, paper or face-to-face contact (Norris 2001).

The economic growth of a country has often been associated with technological advancement (OECD 2007). Therefore, some countries in Sub-Saharan Africa with limited internet and broadband connectivity experience insignificant economic growth (Campbell 2001). The digital divide can, therefore, widen the economic divide between industrialised and the non-industrialised nations (Campbell 2001). It is estimated that the internet economy contributed 1.1 per cent of the African gross domestic product (GDP), and this is far below the 3.7 per cent recorded by industrialised nations (Tracking Africa's progress in figures 2014). Limited internet access and a lack of secure internet servers might bar some businesses and consumers from making transactions online in Africa.

Research conducted on the implications of geographical location of individuals on digital disparities revealed that limited access to ICTs in rural areas affects the ability to use the internet for economic and other activities by rural inhabitants, when compared to individuals in urban areas (Stern, Adams & Elsasser 2009). A lack of access to ICTs also results in rural enterprises mainly using traditional technologies instead of modern technologies which enhance efficiency and production.

Information and communication technologies (ICTs) are further viewed as a major catalyst of international trade. ICTs also give digitalised countries an advantage over the non-digitalised countries (Fuchs 2008). Countries that are on the “wrong side” of the divide are marginalised from the global economy, whereas those that are on the “right side” of the divide are rapidly growing and leading in the global economy. Furthermore, Ragnedda and Muschert (2013) argue that global companies take advantage of low labour costs nationally and regionally. Thus, they produce, dispense, and market goods and services efficiently and economically. This type of networked process results in the disempowerment of some countries, and also weakens national economies, especially those of the developing countries (Castells 2001). Developing countries, thus, remain locked into dependencies on the more industrialised countries, consequently leading to underdevelopment (Ragnedda & Muschert 2013).

Mikre (2011) argues that education systems are being transformed by ICTs, so the “last mile” challenges exacerbate knowledge gap and prevailing social and economic disparities among the industrialised and non-industrialised nations. Individuals in industrialised countries access information on ICTs networks more easily than individuals in non-industrialised countries. In the same vein, Holmner and Britz (2013) argue that due to inadequate investment in human capacity building, Africa does not only have under-skilled labour force but is also a knowledge importer. African universities import most books authored and printed in developed countries (Wawire & Messah 2010).

Furthermore, Sithole et al (2013) argue that in South Africa, urban scholars access ICTs more easily than rural scholars that sometimes cannot even access electricity, hence it is unlikely that they have access to computer laboratories. For students in disadvantaged rural and other low income parts of the country, inadequate access to ICTs, such as household internet, can prevent them from learning digital skills which are required to effectively and efficiently participate in an information society. Such students are not able to tap the benefits of a flexible internet connection that household form of access offer, such as researching for their studies and social networking (Oyedemi 2012). Thus, limited rate of access to ICTs such as the internet among young people in developing nations will have an impact on youth development and consequently disadvantage them from effective participating in society (Koss 2001; Sithole et al 2013).

3.7 Conclusion

Integration of ICTs in the institutions of learning is affected by several factors, for instance, ICT infrastructure, ICT skills and electricity supply. Thus, discussing the position of Africa and more specifically South Africa, in the information society and the digital divide is important in this study. It gives an overview of South Africa's readiness to adopt and use ICTs in teaching and learning. The discussion further reveal that nation is an unequal society, and the digital divide is one of the areas of disparity in South Africa. Dwellers of urban South African areas have relatively good access to resources, for instance, the internet and computers, unlike the dwellers of rural areas, who have limited access to resources. Hence, the existence of the digital divide in South Africa.

The digital divide suggests a binary differential between "information haves" and "information have nots" (van Dijk 2006). ICTs are argued to favour mostly the privileged members of a society and often do not reach the underprivileged in developing countries. Unequal access to ICTs leads, in turn, to the widening of the socio-economic gap, mainly in countries where people are categorised into social strata, such as South Africa (Chisa & Hoskins 2014). A country is stratified if its citizens are classified into social strata of the rich, middle class and the poor individuals. The huge majority of poor individuals in South Africa are unemployed, poverty stricken and socially excluded. The "information have nots" are socially, economically and politically excluded, as argued by Castells (2004). Castells states that if an individual is not integrated into information and communication technology (ICT) networks, then that individual is largely unable to fully participate in the information society (Castells 2004). Such individuals are unable to access information, keep social contact, take part in social services, and political processes (Chigona & Mbhele 2008). Van Dijk (2012) echoes a similar view, that the poverty stricken, lowly educated and non-resourced individuals usually located not only in remote rural areas, but also in towns and cities of poor countries, are becoming more and more marginalised. These individuals are also becoming increasingly expendable in a society characterised by an increase in mechanisation and automation, and a decrease in the demand for labour (Castells 2001).

The South African government has intervened to address ICT gaps through, for instance, establishing telecentres and cyber-laboratories at schools (Thusong service centre 2000). Furthermore, accessibility to ICTs in South Africa has been made possible by liberalising telecommunications markets home (Fuchs & Horak 2008). Fuchs and Horak further explain that having access to technologies does not mean that all people can afford having ICTs at home. Also, accessibility to ICTs does not close the skills gap, and only the digitally competent individuals enjoy the benefits of using digital technology, for instance, e-banking and e-learning. Information and communication technologies literacy skills are, thus, a cause of concern among the rural people and also among some people in poor communities in urban areas. A more open market in the telecommunications sector in South Africa has been hindered by policy constraints (Gillwald 2011). Despite the mentioned challenges, the National Department of Education of South Africa has an e-learning policy which was put in place in order to spread the use of ICTs. Thus, the next chapter is a discussion of the role of ICTs in education.

CHAPTER 4

THE ROLE OF ICTs IN EDUCATION

4.1 Introduction

The previous chapter focused on the position of Africa - and more specifically South Africa - in the information society and the digital divide. The rise of the global economy “powered by technology, fuelled by information and driven by knowledge” has led to changes in educational institutions (Vinila 2016:22). From the information society perspective, the use of ICTs is becoming one of the most important prerequisites for education at every level (Shan Fu 2013). The information society depends largely on the extensive use of information. Individuals should, thus, have ICT skills to fully benefit from the information society. Information, therefore, is important for an individual to survive in such a society. However, the reality of the digital divide means that the integration of ICTs at institutions of learning will be a challenging undertaking (Mikre 2011).

4.2 ICTs in education

Rethinking and reshaping education in the age of technology is of importance if learners and teachers are to keep pace with technological advancements (Groff 2013). As access to information continues to grow, the teacher cannot remain the sole and only fountain of knowledge and learners the mere recipients of that information (Olusegun 2015). Rather, schools could promote the acquisition of knowledge and skills that prepare the learner for life-long learning. Integration of ICTs in teaching can enhance the acquisition of skills required in the information society. However, the effective integration of ICTs in schools is a multi-faceted process. It does not only involve technology, but also pedagogy, curriculum, teacher competencies and school readiness, among other things. Therefore, introduction of ICTs in teaching and learning does not necessarily mean that the possible benefits of the technologies are fully realised (Aktaruzzaman, Shamim & Clement 2011).

Furthermore, the ability to use ICTs such as smart boards and tablets in the classroom prepares the student for the world of work where digital skills are required in the globalised economy (Organisation for Economic Cooperation and Development (OECD) 2016). Schools should, thus, encourage the attainment of digital skills that enable lifelong learning. Equipping learners with skills that are important in the 21st century is necessary for them to be part of the technologically advanced information society (Jaffer, N'gambi & Czerniewicz 2007).

The adoption and use of ICTs in teaching and learning is affected by a variety of stakeholders, such as teachers, learners and school leaders (school ecology) (Zaka 2013). External factors such as professional organisations and parents and/or the community also fulfil important roles in the use of technologies at schools. The teacher is, however, the most crucial species in the education ecosystem (Davis 2008). Teachers play a paramount role in the use of ICTs in teaching and learning because "educational change depends on what teachers do and think" (Zaka 2013:30). The attitudes and readiness of teachers to adopt technologies impact the use of the ICTs in the classroom (see section 4.9.2 on intrinsic barriers to teachers). Teachers' adoption and use of technologies in teaching is also affected by extrinsic barriers (see section 4.9.1).

School leadership is, in addition, important in supporting teachers in adopting ICTs (Yuen, Law & Wong 2013). Zaka (2013) conducted a study in a New Zealand secondary school on how blended teaching and learning was implemented. It emerged from the study that the principal was supportive of blended learning. Consequently, teachers encouraged learners to independently learn and create knowledge. Learners explored teaching tools in their classes, thereby developing new ICT skills. Learners also imparted ICT skills to their parents, who in turn became actively involved in the learning of their children.

The community and/or parents also play crucial roles in the use of ICTs in education. However, it is posited that their role has been "neglected and underestimated" (Fullan & Stiegelbauer 1991:246). It is postulated that some parents' traditional views of education prevent them from understanding the importance of implementing ICTs in education (Zaka 2013). Some parents' lack of knowledge on the importance of ICTs in education might have implications for learners who need support from home. Such parents might not realise the need to buy their children ICT devices, such as tablets and laptops (Zaka 2013).

Having briefly explained the education ecosystem, it is crucial to define e-learning.

4.3 Defining e-learning

Several authorities posit that agreeing on one acceptable definition of e-learning is difficult (Mason & Rennie 2006; Sangrà, Vlachopoulos & Cabrera 2012). There exist a variety of definitions of e-learning. Some definitions conflict the views of other definitions, and some definitions are deduced from comparing defining characteristics with other existing terms (Moore, Dickson-Deane & Galyen 2011).

Scholars such as Nicholas (2003) define e-learning as a form of learning only via web-based tools. Analysts such as Ellis (2004) disagree with Nicholas. Ellis holds the belief that e-learning also covers content and pedagogy that is not only accessible via web-capable tools but also via videotape, interactive television, among other things. E-learning can, therefore, be defined as learning that utilises ICTs to access educational curriculum outside of a traditional classroom (Friesen 2009).

Various categories of e-learning have been posited. These categories are "technology-driven, delivery-system-oriented, communication-oriented, and educational-paradigm oriented" (Sangrà, Vlachopoulos & Cabrera 2012:146).

Technology-driven descriptions emphasise the technological aspects of e-learning. For instance, delivering learning and training programmes through ICTs is a technological meaning of e-learning (E-learning portal 2009). Similarly, Guri-Rosenblit (2005) postulates that e-learning is use of electronic media for teaching and learning in conventional classrooms and in online learning.

In the delivery-system-oriented definitions, e-learning is described as learning through web techniques (Liao & Lu 2008). E-learning is presented as a means in which individuals access knowledge through learning, teaching and training. Delivery-system-oriented definitions mainly focus on the accessibility of resources.

Communication-oriented definitions of e-learning are also posited. E-learning is defined as the use of computerised communication systems as an environment for communication (Bermejo 2005). E-learning is perceived to support and improve learner-to-learner interactions and learner-to-teacher interaction through various communication tools (Agbo 2015).

The fourth category of definitions of e-learning focuses on the educational paradigm. Advocates of this paradigm are mainly from the education sector. It is stated that e-learning is the use of multimedia technologies and the internet to improve the quality of teaching and learning (Alonso, López, Manrique & Manrique 2005; Talsik 2015). Concurring with this definition, Jenkins and Hanson (2003) state that e-learning is learning that is facilitated and supported through ICTs. The internet and multimedia technologies enable students and teachers to, for instance, collaborate, exchange information and research online.

From the four categories, e-learning can be summarised as the use of ICTs, online media and web technologies for learning (Pelet 2014). Three main characteristics of e-learning which can be deduced from the definitions are: content and pedagogics, ways of disseminating content, and methodologies. Furthermore, e-learning is not intended to replace conventional face-to-face classroom teaching. Rather, it is aimed at creating an expanded learning environment in which ICTs are used to deliver various teaching methodologies aimed at capitalising the individual’s participation in the learning process (JISC 2004). E-learning has potential benefits for institutions of learning, which includes learners and teachers.

4.4 Benefits of ICTs in education

The implementation of e-learning in education is bound to confer many benefits for the learners and the institutions of learning (Agbo 2015).

4.4.1 E-Learning tool

Many institutions of learning are exploring new ways of reaching learners and that includes online and blended learning (Watson 2008). The learning management system (LMS) has been adopted to deliver online and blended courses (Sesabo et al 2015). The LMSs are software platforms developed to enable teachers to create online courses to encourage the learners and teachers to interact and collaborate on learning content (Lopes 2014).

Various institutions of learning have adopted LMSs, for instance, the University of Education, Winneba (UEW), in Ghana adopted Moodle and lecturers were trained to use the LMS. Tools that are provided on LMSs include discussion forums, student progress tracking, student self-evaluation, and grading (Mann 2009). These tools enable the distribution of course information and materials to students via the internet. The lecturers used Moodle, for example, to manage learning content and check students' uploaded work. It has, however, been argued that the successful implementation of LMSs does not only depend on training and supporting lecturers, but attention must also be given to the level of students' active use of LMSs (Sanchez-Santamaria, Ramos & Sánchez-Antolín 2012). Research conducted by Sanchez-Santamaria et al at UEW in Ghana revealed that students experienced difficulties in navigating through the course content on Moodle. Some of them could not access course material and upload assignments due to irregular internet access. Furthermore, students only accessed lecture notes and uploaded coursework on Moodle but did not use the LMS to interact and create content. This might be because some students lacked LMS knowledge. Hence they only used Moodle as repository of material and information (Costa, Alvelos & Teixeira 2012). Similar findings were obtained by Nkonki and Ntlabathi (2016) in their study on the forms and functions of teaching and learning innovations on Blackboard, at the University of Fort Hare, South

Africa. Their study revealed that the use of Blackboard among lecturers was limited. Nkonki and Ntlabathi revealed that lecturers used Blackboard as a substitute for the old way of doing things, for instance, the lecturers uploaded material on the LSM for students to access, instead of printing out the material. Simply uploading material online does not necessarily mean that students interact and engage with the material.

Another example of an institution of learning that uses a LMS is the University of South Africa (Unisa). The university is an open distance learning institution and has the highest number of students in Africa (Mkhize, Mtsweni & Buthelezi 2016). Unisa uses a learning management system called myUnisa. MyUnisa is used for teaching and learning, as well as for communication, thus bridging the distance between students and lecturers (Mkhize et al 2016). Research conducted at Unisa revealed that the compatibility and relative advantage of MyUnisa impacted on students' attitude towards LMS (Mkhize et al 2016).

4.4.2 Resources

ICTs can also help to counter negative factors in educational institutions, such as high learner-teacher ratios and shortages of instructional materials (Nawaz 2013). An overcrowded and poorly resourced school makes it difficult for effective teaching and learning to take place. For instance, the Sakhikamva High School in East London had 90 learners in a single Grade 9 classroom (Macupe & Hawker 2012). The use of ICTs could be useful in such a context, where teacher to learner ratios are high (Hart & Laher 2015). Technology can be used to deliver the curriculum, for example, learners can access educational programmes and websites on tablets. In the teaching of, for instance, language, ICTs can assist learners to improve listening and speaking skills, pronunciation and grammar (Mafurag & Moremi 2017; Balagiu, Pateşan & Zechia 2018).

A survey conducted among students around the world revealed that students used either a tablet or a smartphone to access academic information, for instance grading, course materials and course schedules (Goad 2012). The reasons for these preferences are probably the fact that portable devices allow consistent

access to course resources. Through mobile technology, learners have access to diverse communication options, for instance email, blogs, video and voice calling and text messages, which permit learners to collaborate on schoolwork and exchange learning resources (Jacobs 2011). Furthermore, portable devices can also display educational games, which measure learners' progress and allow teachers to personalise learning in order to suit each individual learners' needs (Valk, Rashid & Elder 2010). Therefore, if all learners have mobile technology devices and access to the internet, then they have access to rich information and abundant ideas (Spires, Wiebe, Young, Hollebrands & Lee 2012). It is even postulated that the use of exercise books is out-dated for learners living in the digital world. Hence learners should have access to ICT infrastructure such as tablets and smart phones (van Deursen, Allouch & Ruijter 2016).
Research conducted at schools in Soweto in the Gauteng Province revealed that most of the low/no fee schools had books irrelevant to curriculum in their libraries (Paton-Ash & Wilmot 2015). Moreover, the donated books were outdated. Thus, if ICTs are adopted, suitable learning material in almost every subject can be accessed on the World Wide Web. Teachers and learners will no longer rely only on hard copy materials in housed school and community libraries, for teaching and learning needs.

Furthermore, ICTs can play an important role in assisting underqualified teachers. Some countries are faced with an increasing shortage of teachers and are also struggling to meet a growing demand for education (UNESCO 2006). It is estimated that 25 per cent of teachers in Sub-Saharan Africa are not qualified. South Africa, for instance, has almost 10 000 under-qualified and unqualified teachers (Magwedze & Nicolaides 2016). In addition, the teachers' experience and qualifications often do not match the requirements of their teaching posts, and that impacts on the quality of teaching. Teachers can access training programmes, courses and collaborate with other teachers online across the globe (Guemide & Benachaiba 2012). Educators can utilise ICTs to obtain additional qualifications or to just broaden their horizons in terms of information, skills and knowledge. Teachers can upgrade their qualifications via distance education through universities such as the University of Johannesburg and the University of South Africa.

4.4.3 Assessment tools

Teachers with adequate ICTs skills may use technologies to present and monitor learners' work (Kang, Heo & Kim 2011). Concurring with this view are Moeller and Reitzes (2011) who argue that the use of ICTs can equip teachers to diagnose and address the learning needs of individual learners. Technologies enable both formative and summative e-assessment. Technology-based assessment has two visions. The first one is a mastery learning strategy which permits teachers to benchmark learners. The mastery learning strategy provides teachers with information about which content has been mastered well and which will require additional instructional attention. The other vision is tied to accountability systems, which result in a system of benchmarking students as they progress through a standard-based curriculum. It produces a picture of a student's thinking. Both approaches enable the teacher to establish a baseline from which to serve as mentors and provide guidance to learners. Furthermore, assessments done through the computer increase the reliability of score marks; the marker has little room to manipulate marks or grades (Chigona, Chigona, Kayongo & Kausa 2010).

Technology in education creates new opportunities for innovation and at the same time presents challenges, for instance, inadequate ICT skills among teachers and limited access to ICT infrastructure.

4.5 E-learning challenges

Though the adoption and use of ICTs in teaching and learning has several benefits, it also has its own challenges. Challenges associated with teaching using ICTs are categorised as technological, contextual, course challenges and individuals' characteristics (Ololube 2009; Chigona & Chetty 2012; Sesabo, Mfaume & Msabila 2015). Individual characteristics, for instance inadequate and/or a lack of digital skills training of teachers and students for the digital age, hamper the implementation of e-learning. For instance, a study conducted at secondary schools in Lesotho revealed that some teachers in rural areas were not exposed to professional development (Kalanda & De Villiers 2013). Similar findings were obtained from Tella, Tella, Majekodunmi, Toyobo, Adika and Adeyinka's (2007) study, which examined Nigerian secondary school teachers' uses of ICTs. The study revealed that teachers lacked expertise in teaching using technologies. These impediments hindered teachers from adopting and using ICTs.

The adoption and use of ICTs in teaching is also affected by teachers' attitudes. It is postulated that these attitudes toward technology can vary from positive to negative depending on different factors that may influence these attitudes (Mustafina 2016). Teachers who have negative computer attitudes are less likely to adopt and use ICTs in teaching, than those with positive computer attitudes (Ertmer et al 2012; Agbo 2015; Gyamfi 2017).

Factors that influence teachers' attitudes toward ICTs integration include computer anxiety, ICT knowledge, training, perceptions of ease of use and usefulness (Sabzian & Gilakjani 2013). A study conducted at a Kazakhstan secondary school revealed that teachers possessed positive attitudes toward ICT in school mostly due to the advantages afforded by that ICT, such as distant learning and visualisation of the material (Mustafina 2016). Teachers were also confident and knowledgeable of ICTs, hence integrated technologies in teaching and learning. Similar findings were obtained from a survey conducted across 93 schools in KwaZulu Natal Province (Govender & Govender 2009). Teachers who perceived ICTs to be advantageous and compatible had positive attitudes towards computers. Govender and Govender also found out that 68.1 per cent of teachers had limited ICT skills and only 15 per cent of teachers used computers for teaching.

Ertmer et al (2012) explain that teachers' negative beliefs about the use of technology to learners' learning and their own limited knowledge are barriers to ICT adoption. Concurring with Ertmer et al are Nsolly and Charlotte (2016). Nsolly and Charlotte's study in Cameroon revealed that teachers' attitudes and beliefs towards ICTs are a barrier to ICT integration in the classroom. The majority of the Cameroonian teachers showed no interest in acquiring knowledge in the adoption and use of ICTs in teaching. Some teachers even refused to be trained by their colleagues who run the school multimedia resources centres.

Furthermore, transforming some teachers' conception of new methods of teaching using ICTs can frustrate the teachers. It can also cause anxiety and tension, as the teachers might feel that they do not have the needed ICT skills to use technology in the classroom (EL-Halawany 2014). Therefore, it is necessary for prospective teachers to be adequately equipped with ICT skills. However, research conducted in South Africa showed that most of the newly qualified teachers are not able to deliver the curriculum using the new technologies (Chigona 2015). Chigona further argues that prospective teachers can be assisted in adopting ICTs in the classroom by integrating the technologies into their teacher training courses. Integrating ICTs in teacher training courses allows the teachers to experience ICT-based methodologies.

Šolc et al (2012) argued that teachers need to invest a lot of time and effort to prepare e-learning materials. The challenge faced by some teachers is lack of knowledge on how to motivate students to be active participants in e-learning courses. Furthermore, teachers who do not like e-learning may negatively impact on learners' motivation (Sun et al 2008). A study conducted by Paechter et al (2010) confirmed that students' achievement goals and the teachers' skills and knowledge have an impact on students' satisfaction and their learning. Teachers need to know how to motivate students and promote both independent and collaborative learning skills.

A study conducted by Sesabo, Mfaume and Msabila (2015) revealed challenges related to for instance, individual and technological domains essential for the adoption and implementation of e-learning. A study on the extent of awareness of academic staff on e-learning system and adoption at Mzumbe University in Tanzania revealed that there was a low awareness of e-learning tools and that few features within the e-learning system were used by teachers. Teachers revealed that they lacked knowledge on how to use features of the learning management system (LMS). The academic staff only uploaded learning materials on the LMS. The adoption of ICTs in teaching was, therefore, very low with only 20 courses out of 100 courses taught at the university were uploaded on the system (Sesabo et al 2015). Some of the technological challenges faced by the academic staff at Mzumbe University included poor internet connectivity and limited availability of software tools that facilitate online teaching and learning.

It is also of importance to note that the use of mobile technology in teaching and learning has its drawbacks (Liaqat 2018). A study on the perceptions and barriers to ICT use among English teachers in Indonesian revealed that teachers were of the view that learners might access incorrect information on some websites, develop inappropriate knowledge, and the learners tend to use short forms in their writing (Goad 2012**;** Muslem, Yusuf & Rena 2018). The teachers further argued that learners sometimes use mobile phones to text their friends during class, which distracts from classroom lessons, risking poor performance (Gerald, MacLeod, Frost and Waller 2017). Cyberbullying and cheating might also occur in classrooms where mobile technology is permitted (Willard 2007**;** Pedro, de Oliveira Barbosa & das Neves Santos 2018).

The integration of ICTs in teaching and learning has resulted in changes in modes of teaching. Traditional methods of teaching have also been modified by the adoption and use of ICTs in teaching and learning.

4.6 Modes of teaching

Traditional methods of teaching confine learning to the classroom walls, but advances in ICTs have provided alternative ways to teaching and learning (Umugiraneza, Bansilal & North 2018). The adoption and use of technologies, such as the internet, has led to the rise of blended and online learning.

4.6.1 Traditional mode

The traditional mode of teaching entails teacher-centred interaction where the teachers serve as the fountains of knowledge while the learners are mere recipients of knowledge (Phillips, Wells, Ice, Curtis & Kennedy 2008). This method of teaching is based on a precondition that learning takes place if an individual is in a class and listens to the teacher. The teacher gets feedback from the learners in the form of their homework or through examinations. It is argued that if class time is efficiently used and clear rules are set to manage learners' behaviour, then traditional methods of teaching are likely to succeed (Adams 2014).

Students who would want to build rapport among their peers and lecturers as well as seek an in-depth learning experience may decide to attend face-to-face courses (Lauver, Drum, Windsor & Miller 2013). In a classroom setup, social awareness is natural; students observe the reactions of other students and their instructors. Interaction with classmates is also easier in the traditional classroom. The physical arrangement of desks, a blackboard and audio-visual equipment play a crucial role in the interaction between students and teachers. Social and intellectual interactions are immediate and efficient.

In the face-to-face mode of teaching, the body language and facial expressions of learners serve as feedback mechanisms for teachers (Wuensch, Aziz, Ozan, Kishore and Tabrizi 2008). This is confirmed by the research conducted at the Memorial University of Newfoundland in Canada on students who were taking on-campus courses (Delaney, Johnson, Johnson & Treslan 2010). The students noted that the act of being in one another's presence allows facial and body language communication.

Traditional learning is, however, confined to the classroom. Some institutions of learning now blend the traditional mode of teaching with ICTs. This is done in order to extend learning beyond the classroom. The use of LMSs creates a platform for blended learning.

ICTs do have a potential role in the traditional mode of teaching and learning (Mikre 2011). Technology can be used to enhance collaboration during face-to-face teaching. For instance, Nussbaum, Cortez, Rodriguez, Lopez & Rosas (2005) stated that Pocket Personal Computers interconnected by a wireless network (Wi-Fi) were used to teach subjects such as Mathematics and Biology. The handheld wirelessly interconnected computers permit social interaction between members of a learning group. Learners can simultaneously create content on Google tools such as Google docs, in the classroom. A teacher can ask learners to respond to a class brainstorm on a particular topic using a centralized Google doc. Each student can anonymously display their brainstorms to the entire class to encourage a discussion.

Another ICT tool that can be used to enhance traditional modes of teaching and improve learning is an interactive whiteboard (Davidovitch & Yavich 2017). Davidovitch and Yavich posit that an interactive whiteboard provides a presentation tool that can be used for teaching the entire class, and promotes student engagement with ICT. Learners can work in groups on projects using the interactive whiteboard. Research studies also revealed that interactive whiteboards motivate learners' interests and participation during teaching and learning (Aytaç 2013).

The traditional mode of teaching has been modified by blending it with ICTs (Lu & Price 2018). This enhances a more flexible and dynamic interaction between learners and teachers. Teaching and learning occurs beyond the traditional classroom.

4.6.2 Blended mode

Blended learning is a combination of technology-enhanced instruction and face-to-face teaching and learning (Negash, Wilcox & Emerson 2007; Gonza´lez 2012). The teacher and learners meet in the classroom and electronic devices, such as tablets, smart boards and computers are used as a means to deliver part or all of the course material (Harasim, Hiltz, Teles & Turoff 1995).

The concept of blended learning changes the role of the teacher and the learners (Pool, Reitsma & van den Berg 2017). Teachers are now educational facilitators rather than mere dispensers of knowledge. Students also experience changes. They can no longer be passive recipients of information from the teacher, but become active participants in their own learning.

Blended learning combines synchronous and asynchronous elements (Boguslaw, Scott & Jill 2017). Synchronous elements include face-to-face meetings, video conference meetings and chats. On the other hand, asynchronous elements include recorded lectures, discussions, and collaboration (Norberg et al 2011). People at different locations and time zones, can therefore, interact together. ICTs play a major role in supporting students' asynchronous work. For instance, students can upload assignments on the learning management systems (LMSs) and can also conduct discussion forums on the LMSs.

Factors that are argued to be the key to the successful implementation of blended learning are the learner and the institution (Poon 2014). Learners must be equipped with ICT skills so that they are able to navigate the ICT tool used in blended learning such as a LMS. The teachers must also be trained on how to use ICTs to deliver the curriculum (Harris, Connolly & Feeney 2009). The institution is required to provide all the support needed by teachers and learners so that blended learning is successfully implemented.

ICTs that can be used in blended learning include Web 2.0 technologies, such as wikis and social networking sites, for instance Facebook, and video sharing, for instance YouTube (Bower 2015). These tools are also used for fully online learning. Web 2.0 claims that if these tools are used in teaching and learning then students will not be passive recipients of information (McLoughlin & Lee 2010). Rather, students will be active participants who can personalise their learning. Research findings at Greek primary and secondary schools confirm the claims by Web 2.0 enthusiasts (Palaigeorgiou & Grammatikopoulou 2016). The introduction of Web 2.0 technologies at Greek schools enabled learners to be creative and publish their own work. Learners discussed and shared lesson notes on, for example, Facebook. Teachers create videos, post the videos and learners comment on the videos, and the discussions continue in class. Learners, on the other hand, can create and share information and utilise, evaluate and deliver their opinions on peers. Their opinions on peers served as a critic of information shared among themselves. Blended learning requires motivation for continuous and active engagement.

Despite the advantages of Web 2.0 technologies, there are some teachers who are not convinced of their advantages. It is argued that the limitations and weaknesses of the institutions of learning are not taken into consideration by Web 2.0 enthusiasts. Research has enumerated many challenges faced by teachers in their endeavour to adopt Web 2.0 tools into their teaching practices (Palaigeorgiou & Grammatikopoulou 2016). These barriers are discerned into two categories: external barriers, which are include access to ICTs, training and technical support, and the internal barriers, which concern teachers' attitudes and beliefs toward technology (Ertmer 1999) (see section 4.9).

Furthermore, the key to successful blended learning is the learner's ability to manage time. However, Smyth, Houghton, Cooney and Casey's (2012) study on students' experiences of taking a blended learning in a school of nursing and midwifery, at the National University of Ireland, revealed that some students had inadequate time management skills and find it difficult to accept responsibility for their own learning. Others felt isolated because blended learning had less opportunities for them to interact socially with their classmates (Smyth et al 2012).

A research conducted by Poon (2014) on blended learning in property education courses in the UK and Australia revealed some of the challenges that academics were facing. The Australian academics' main challenges included finding it difficult to cope with rapidly changing technology. Internet connection was also a challenge, considering the fact that Australia has remote areas. In the UK, academics revealed that some of their students were less willing to participate in online teaching and learning activities (Poon 2014).

Some institutions of learning offer both blended and online courses to students. Some students, especially post-graduates, are usually full-time employees who need to balance work and education (Millson & Wilemon 2008). Institutions of learning, thus, provide online courses (Ladyshewsky 2004).

4.6.3 Online mode

Online learning can be defined as a teaching and learning approach that utilises the internet to communicate and collaborate in an education context (Feldman & Zucker [sa]). It provides two-way communication through the internet. Learners communicate with each other and with teachers. Web technologies are used to distribute content as already discussed under the blended learning mode. It enables opportunities for distance-learning and personalised learning. Another advantage of online learning is that learning material can be kept up-to-date by simply uploading on the server and learners immediately get access to the improved material (Kwofie & Henten 2011). Both synchronous and asynchronous learning are facilitated by online learning.

A high quality online learning experience can be achieved if the teacher uses teaching methods that stimulate active learning among students (Lang & Costello 2009). Activities that promote collaboration, communication and inquiry among learners need to be included when designing pedagogies for online courses (Huynh 2005; Redpath 2012). With ICTs and access to resources, learners are motivated to become creators of knowledge, collaborators, and problem solvers (Moeller & Reitzes 2011). Confirming Moeller and Reitzes' argument is a case study conducted by Johannes (2007) at the Soshanguve Technical High School. The research revealed that learners who took the online course in entrepreneurship improved their learning and increased their creativity, ability for innovation and their entrepreneurial thinking. By being innovative, creative and employing their entrepreneurship ability, learners were able to produce products.

However, research conducted at the Royal University of Bhutan revealed that although teachers were trained on how to use learning management systems (LMSs) and their features, the dominant usage remains limited to a few features such as uploading assignments and uploading module descriptors (Penjor, Dupka & Zander 2016). Some lecturers revealed that lack of time was a constraining factor. Preparing and uploading learner material on the LMS, among other things, took a lot of time. Limited skills and poor internet connectivity were also mentioned as factors hindering the effective use of the LMS. It can, thus, be deduced that the LMS was predominantly used as a mere add-on.

It is also argued that for effective online teaching and learning to occur, three types of interaction should be catered for, namely “learner-content interaction, learner-instructor interaction and learner-learner interaction” (Xiao 2017:124). Teachers should, thus, use tools on the online learning platform which promote all the three types of interaction. For instance, learners engage in online discussions among themselves and with their teacher. Discussion forums enable text discussions among users, and contributions are organised according to discussion threads (Bower 2015; Njoku 2015).

Communication, flexibility, feedback, the roles of learners or teachers, and the quality of course material were the focus of a number of studies on online teaching (Young 2006). The teacher’s role is facilitating learning and the learner is an active participant in the teaching and learning process. Given these roles, research revealed that students’ concern about teacher effectiveness in online courses focused on communication (Northrup 2002). The students noted that time responses from teachers were the most valued interactions. Concurring with Northrup are Hara and Kling’s (2000) findings in their study of university students’ distress with a Web-based distance education course. Hara and Kling found out that students were distressed by communication issues, which included communication breakdowns and keeping up with frequent and lengthy email discussions. The students were also frustrated by ambiguous communications from their teachers and the lack of spontaneity in the online environment.

Research to explore student satisfaction with online learning was conducted by Arbaugh, Godfrey, Johnson, Pollack, Niendorf and Wresch (2009). The findings revealed that human interaction was still a necessity. Merely uploading information on a LMS was less effective since some learners could not learn on their own (Ladyshewsky & Taplin 2014). Learning is, thus, not caused by ICTs but by the teaching method embedded in the online media (Delaney, Johnson, Johnson and Treslan 2010).

The advent of ICTs at institutions of learning has led to the modification of traditional methods of teaching. Blending traditional learning methods with online learning improves accessibility to education. Learning is no longer confined to the classroom walls but can be accessed anywhere and anytime through the use of ICTs.

4.7 E-learning policy in South Africa

The e-learning policy of South Africa states the goal of e-learning thus:

> Every South African learner in the general and further education and training bands will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013 (South Africa: Department of Education Draft 2003: 10).

According to the South African Department of Education, e-learning should not merely result in the development of computer literacy, but should also foster the ability to effectively apply ICT skills to access information. Merely accessing information is not adequate. Rather, an individual should also be able to analyse, evaluate and integrate the information. The ability to present and communicate the accessed information is a further skill that individuals should possess. Individuals with adequate ICT skills can effectively and meaningfully function in an information society using the appropriate technology (South Africa: Department of Education Draft 2003:7).

ICT projects have been implemented in South Africa to enhance achieving the e-learning policy goals. Some of the projects focus on training teachers and learners, such as the Thutong Portal and the Khanya Project (Isaacs 2007). Other ICT projects mainly focus on rolling out ICT infrastructure in schools, such as the Gauteng Paperless Classroom Project (South Africa Government 2015; South

African Government News Agency 2015). The projects have both successes and challenges, as discussed in section 4.8.

4.7.1 E-learning in South Africa

In South Africa, the aim of e-learning is perceived to learners and teachers through ICTs (Smit & 2013). E-learning, thus, centres thus on the integration of ICTs to fast-track the attainment of educational goals. The aim of e-learning is to connect learners and teachers, through ICT networks, to one another as well as to experts in various subjects (South Africa: Department of Education Government Gazette Draft 2004). Through the use of ICTs, teachers are expected to improve their teaching practice and learners will learn better (South Africa: Department of Education 2004). It can be inferred that policy makers in South Africa assume that with ICTs in schools and a policy that promotes e-learning, teachers will change their teaching practice and adopt new teaching methods. However, the successful implementation of the e-learning policy in South Africa depends upon several factors such as the school environment, the availability of adequate ICTs and the teachers' ICT skills. Key elements that are supported by the e-learning policy framework for the use of ICTs in teaching and learning include equity and access to ICT infrastructure (Blignaut & Howie 2009). Equity and access to ICTs are, however, far from being achieved in the South African context.

4.8 ICT initiatives and projects in South Africa

The South African Department of Education acknowledges that the quality of education in the country is below international standards and a collaborative effort is required to improve education (South Africa: Department of Education 2007). Concurring with the Department of education is the News24 Correspondent (2017) who reported that South Africa has one of the world's worst education systems.

The Trends in International Mathematics and Science Study (TIMSS) revealed the mediocrity of education in South Africa (Spaull 2013). The TIMSS's aim is to compare learners' achievement across participating countries (Reddy, Visser, Winnaar, Arends, Juan, Prinsloo & Isdale 2016). In 2011, the TIMSS indicated that South African learners had the lowest performance among all 21 middle-income countries that participated (The Centre for Development and Enterprise 2013). Mathematics and Science scores were at 352 and 332 respectively in 2011 (Human Science Research Council 2012). The TIMSS achievement scale has been set with a centre point of 500 (Reddy et al 2016). An analysis of the Grade 9 TIMMS 2015 study was done by the Human Science Research Council (HSRC) (Reddy 2016). The TIMMS 2015 study showed that the Mathematics and Science scores had improved to 372 and 358, respectively. These TIMSS results are further clarified by Reddy et al (2016). Reddy et al argued that in 2015, 34 per cent of Mathematics learners and 32 per cent of Science learners achieved a score of over 400 points. This means that three quarters of Grade 9 learners in South Africa did not achieve the minimal level in Mathematics and Science. Thus, it is that postulated that the education system of South Africa is poor (Kwinana 2017).

It is not only in Mathematics and Science where learners' performance is very low, but the entire education system of South Africa is ranked as one of the lowest in the world. According to the News 24 correspondent (2017), the OECD ranked South Africa 75 out of 76 countries in 2015. The poor performance of learners might be due to disparities in resources during apartheid-era Bantu Education (News 24 correspondent 2017). This argument was however refuted by the former Minister of Education, Naledi Pandor. Pandor argued that apartheid and a lack of resources are no longer justifiable arguments to defend the mediocrity of the South African education system (Brand South Africa 2007). The quality of teachers in schools, among other things, could also affect learner performance.

The quality of teacher training and the professional courses that teachers undergo play an important role in determining the overall quality of education. Teachers have the most direct contact with learners and have considerable control over the teaching and learning environment and what is taught. Therefore, improving teachers' teaching skills and knowledge of the subject content is one of the crucial steps to improve learner achievement (King & Newman 2001).

Thus, the initiation of ICT projects represents an attempt to improve the quality of teaching and learning in South African schools (Isaacs 2007; South African Government 2010; South Africa: Current ICT initiatives [sa]; South Africa Government 2015; South African Government News Agency 2015). Some of these projects are discussed in the sections that follow.

4.8.1 Rollout of tablets to school learners in Gauteng

The Gauteng Provincial Department of Education started the Paperless Classroom Project in 2015 (South Africa: Current ICT initiatives [sa]). The project targets no-fee paying schools. These are the poorest schools in South Africa and allow learners to enrol without paying any school fees (Sayed & Motala 2012). The government allocates the no-fee paying schools a larger amount of funding from the national budget per learner to make up for the school fees that are charged at schools in more prosperous areas (South Africa: Department of Education 2017). These schools are mostly situated in disadvantaged communities such as townships. The Paperless Classroom project entails the use of smart boards and tablets which are connected to unlimited internet. The tablets have relevant e-learning content already installed (South African Government News Agency 2015). The tablets were also issued out to some learners at no-fee paying schools in the province. Smart boards connected to the internet were also installed in some classrooms. The aim of this initiative is to create a "paperless classroom" to benefit the learners.

However, this project has faced various setbacks, which include burglary at schools which received tablets and also vandalism of computers and school furniture during service delivery protests in some communities (Czernowalow 2015). The running of the schools has, thus, been disrupted in such areas. Burglary at schools led the current Gauteng Education Member of the Executive Council, Panyaza Lesufi, to recall all the tablets from schools across the province so that the department could tighten security at the schools (Czernowalow 2015).

The recalling of tablets meant that the learners were disconnected from the internet and e-learning content. Consequently, teachers had to resort to traditional teaching methods again.

Other challenges linked to the roll-out of technology and e-learning were highlighted by van der Walt, the shadow deputy minister of Basic Education of the Democratic Alliance (DA) (Czernowalow 2015). He argues that some teachers have limited ICT skills. He also argues that if e-learning is implemented, an information technology (IT) specialist will be needed at each school to assist teachers who might face technical problems. Confirmation of van der Walt's arguments came from a research study conducted by Kabe, Kalema and Motjolopane (2015) at a number of secondary schools in the Tshwane District. The study revealed that providing ICT facilities to schools and implementing projects such as the Gauteng Online Project, had realised little benefits towards e-learning success. A lack of ICT skills among teachers and insufficiently trained ICT facilitators were identified to be failing these projects, among other factors.

The rolling out of technology in South African schools at national levels is also fragmented, despite the government's intent to connect all schools to broadband and supply other ICTs required in teaching and learning (Czernowalow 2015), the reason being that each provincial government is allocated a budget for education. Provinces which prioritise the use of ICTs in teaching and learning over other issues lead in e-learning, such as the Western Cape and Gauteng provinces while other provinces lag behind (South African Government News Agency 2015).

4.8.2 Khanya Project

The Khanya Project was established in 2001 in the Western Cape as a provincial government programme to address a lack of ICT skills among teachers and the need to teach subject content through the use of available and affordable technology. Computer facilities (computer laboratories) were, thus, installed in some schools (Western Cape Department of Education 2014). The Khanya Project focuses on training teachers on how to use ICTs to enhance teaching and learning. The project mainly focuses on schools in disadvantaged communities, with the goal of bridging the digital divide between poor and rich schools. The Khanya Project also aims at empowering community members, teachers and learners to use ICTs optimally.

The impact of using ICTs to teach Mathematics was analysed for some schools under the Khanya Project. A longitudinal study to investigate the relationship between the use of the ICT-based Master Mathematics Programme and Mathematics scores on standardised tests was conducted by lecturers of the University of Cape Town (Wagner, Day, James, Kozma, Miller & Unwin 2005). The study comprised “experimental” and “control” schools. The experimental schools received the experimental procedures, that is, the ICT-based Master Mathematics Programme was used to teach Mathematics. On the other hand, the ICT-based Master Mathematics Programme was not administered at control schools. The results revealed that the Mathematics scores for learners using the ICT-based Mathematics Programmes were significantly better than Mathematics scores of learners who were not using the ICT-based Maths Programme. It can, therefore, be concluded that ICTs can improve the performance of learners if appropriately integrated in teaching and learning.

The project also aimed at empowering all teachers in the Western Cape to use suitable ICTs to teach various subjects by 2012 (Isaacs 2007; Rahimi, Beer & Sewchurran 2012). This goal was too ambitious, taking into consideration other factors entailing the adoption and use of ICTs at schools. Factors that affect the adoption and use of ICTs at schools include limited ICT skills among learners and teachers’ attitude towards the use of technology. These factors will be explained in the discussion of barriers to the adoption and use of ICTs at some schools in South Africa (see section 4.9).

4.8.3 Thutong Portal

The Thutong Portal was developed and launched in 2005 by the Department of Education, in collaboration with provincial departments and other stakeholders (Isaacs 2007). Thutong is a Setswana word meaning “place of learning”. The

Thutong Portal has a database of annotated web-based curriculum resources for various subjects and grades (Brand South Africa 2012). The portal was developed with the aim of providing access to syllabi and other material applicable to education in South Africa. The material is accessible to teachers, learners, school managers and parents. The portal also focuses on creating online communities of practice. Users can connect and share information with subject experts and peers within and outside South Africa. The virtual communities are set up according to interest groups such as teacher education, mobile learning, and school management (Brand South Africa 2012). The portal is a free service to registered users, and the resources on the portal are designed to develop lifelong learning (Isaacs 2007). Teachers, learners, school managers and parents can register on the Thutong Portal. Teachers can access and use the ICT tools such as blogs and discussion forums to express their own views, seek guidance and contribute materials through uploading on the portal.

4.8.4 Intel® Teach

Intel® Teach is a professional development programme of the South African Council for Educators (SACE). The programme is aimed at preparing teachers and learners in adopting and using modern ICTs in teaching and learning (Isaacs 2007). Today's knowledge economy depends upon the ability of learners and teachers to be independent lifelong learners, hence the establishment of the Intel® Teach initiative. Teachers who participate in the programme are intensively trained on how to apply modern ICTs in the classroom. The teachers are not merely taught how to operate a computer, but how, when and where to incorporate ICTs in the teaching and learning process (SchoolNet SA 2012). The training of teachers is done at their schools by skilled facilitators. SchoolNet SA provides training and the project is funded by either the provincial government or by the schools. Teachers who progress in the modules in the Intel® Teach programme can collaborate with others and share ideas on how to use ICTs in teaching and learning. The teachers are not only taught ICT skills for the classroom, but also how the develop learners' higher-order thinking skills (SchoolNet SA 2017).

However, a survey conducted by Wilson and Thomson [sa] revealed that not all teachers who completed the Intel® Teach programme were utilising ICTs in teaching and learning. Of the sample surveyed, 48.5 per cent revealed that their learners used ICTs within their lessons once per month. 28.8 per cent of the sample surveyed revealed that they had not yet used any ICTs in their lessons. Various reasons can be forwarded for these findings. Schools in South Africa have varied contextual constraints, which include limited numbers of computers and inadequate computer skills among learners. Hence some teachers abandoned integrating ICTs in their lessons. It was further found out that the majority of teachers who had not yet integrated ICTs in the classroom were mainly teaching in rural schools. Failure to adopt and use ICTs in teaching and learning at rural schools could be as a result of scarce facilities, large classes, and other factors (Human Science Research Council 2005). Rural schools, therefore, need a lot of support in terms of continuous ICT training and the provision of adequate technology.

4.8.5 Teacher Laptop Initiative

The Teacher Laptop Initiative Project commenced towards the end of 2008 and was managed by the Education Labour Relations Council (ELRC) (Tubbs 2013). The project was one of the Department of Education’s cohesive plans for improving the quality of education by providing resources to teachers and learners in the public education sector. The aim of the project was to equip teachers at public schools with laptops by 2011, in an attempt to improve the standard of education (Rasool 2012). Qualifying teachers were provided with an ICT package consisting of a laptop, national curriculum software and internet connectivity “with a monthly allowance of R130 per months for 60 months” (South Africa: South African Government 2010; Tubbs 2013).

Media reports state that this initiative fell by the wayside due mainly to problems of funding (Tubbs 2013; Mzekandaba 2015). The then Deputy Minister of the Department of Telecommunications and Postal Services (DTPS), Hlengiwe Mkhize argued that South African teachers still needed training on how to use

ICTs in teaching (Mzekandaba 2015). Mkhize further argued that providing ICTs to teachers without having trained them to use the technologies and understand the benefits of the ICTs is futile (Mzekandaba 2015). Media reports confirm Mkhize's argument (Mzekandaba 2015). Some teachers who were given laptops in the Mount Fletcher and Bizana districts in the Eastern Cape Province revealed that they had never used the ICTs in teaching learners (Macupe 2017). The teachers were never trained on how to use them.

The conclusion that can be drawn is that many ICT projects in South Africa are characterised by challenges which hinder the implementation of technology in some schools. These challenges include inadequate ICTs, limited ICT skills among teachers, and teachers' attitudes towards ICTs use in teaching.

4.9 Barriers to ICTs implementation in South African schools

The availability of ICTs at schools does not automatically imply that the technology is used for effective teaching and learning (Mingaine 2013). There are factors that hinder the adoption and use of ICTs. These factors are classified as first order barriers "extrinsic" to teachers and second order barriers "intrinsic" to teachers (Ertmer 1999). Extrinsic factors include time, training and access to ICTs (Mulwa & Kyalo 2013). Intrinsic factors, on the other hand, include teachers' attitudes, beliefs and resistance to ICTs. Intrinsic and extrinsic factors either hinder teachers from adopting and using ICTs in teaching and learning, or motivate teachers to use technology in teaching.

4.9.1 First order barriers to ICT adoption

First order barriers are extrinsic to teachers. These barriers include a lack of time, inadequate training and a limited access to ICTs (Mulwa & Kyalo 2013).

Lack of computer skills

Inadequate ICT training and experience explain why some teachers are unwilling to use technology in teaching (Eshetu 2015; Elemam 2016; Ngoungouo 2017). In the same vein, Balagiu et al (2018) argue that limited exposure to ICTs is inadequate in equipping teachers with digital skills and the knowledge necessary for mastering the use of ICTs in teaching and learning. This was revealed by the poor performance of most teachers who were enrolled for an Advanced Certificate in Educational Computing at the University of Johannesburg (Van der Westhuizen & De Bruin 2005). The teachers were all selected from schools which had computers. The average mark for the theoretical examination was 38.83 per cent, with 70 students out of 99 failing to obtain 50 per cent in order to pass. The average mark for the practical examination was 55.64 per cent, with 44 students failing to achieve a 50 per cent pass mark (Van der Westhuizen & De Bruin 2005). It can therefore, be concluded that many teachers lack ICT skills. There is a need to equip the teachers with digital skills if ICTs are to be adopted and used in schools. Some of the reasons forwarded by teachers for their poor performance were the fact that they did not have access to the computers at their schools. Some were also denied access to the available computers by the school principals. A lack of support from the school management also hinders the adoption of technology in teaching and learning. The rolling out of ICT infrastructure to schools is not adequate.

Similar findings were obtained in the study by du Plessis & Webb (2012b) in Missionvale Township, Port Elizabeth. The study focused on teacher views of the impediments related to using ICTs in schools. Forty per cent of the participants indicated that teachers in six disadvantaged township schools lacked computer skills. It can be argued that limited and/or lack of ICT skills among teachers might result in schools failing to use technology in teaching and learning. Furthermore, the fact that some teachers lack computer skills serves as an indication that the teachers did not receive sufficient ICT skills training. Occasional workshops are inadequate to change the way teachers teach. It is argued that 30 to 100 hours of professional development spread over six to twelve months is necessary to equip teachers with the necessary skills (Spires et al 2012). Similar findings are reported by Rabah (2015), on a study among Quebec English teachers. The teachers argued that although they were trained three or four times in a year on how to use ICTs in the classroom, that was not sufficient. The teachers needed more professional development and support for them to integrate technologies in teaching and learning.

Furthermore, the quality of the learning experiences that teachers undergoing in professional development courses and the skills that they are equipped with, are of importance. The study by Young (2016) investigating the attitudes of primary school teachers in Ireland towards using tablet computers revealed some of the barriers that teachers faced when using ICTs in the classroom. Knowledge and skills were the most common barriers to the use of technologies in the classroom. For instance, very few teachers used Web 2.0 technologies. Young explained that the professional development courses did not focus on Web 2.0 technologies and, consequently, appeared poorly understood by most teachers.

The socio-economic context of learners may also affect the adoption and use of ICTs at school (Chigona 2010). Learners from poor families do not have computers at home and thus lack computer skills and will probably display a low propensity to the use of ICTs. Research findings from schools under the Khanya Project in Cape Town indicated that some teachers were demotivated from using ICTs when teaching because their learners had poor ICT skills (Chigona 2011). The Khanya Project only trained teachers on how to use ICTs but did not train the students. So some teachers ended up teaching their learners basic computer skills instead of teaching subject matter. Thus, some teachers avoided ICTs (Chigona & Mooketsi 2011). Only training teachers in ICT skills is, consequently, not sufficient to enable the adoption of ICTs in schools. It is, therefore, necessary to train both teachers and learners in digital skills if ICTs are to be used in teaching and learning.

Work environment

School managements play an important role in the adoption and use of ICTs at schools (Thomas 2006). A work environment can either motivate or demotivate teachers from using ICTs in teaching and learning. Albugami and Ahmed (2015:41) argue that if the school headmaster is not supportive of ICT-related developmental courses for teachers, ICTs will probably not be applied in that particular school. Furthermore, in an environment where teachers feel forced to use ICTs, they will tend to resist using the ICTs in the classroom.

It is further argued that ICT projects in South African schools often fail because school principals are not well-informed about the advantages of using ICTs in teaching and learning (South Africa: Department of Education 2004). Teachers interviewed by Ogunniyi (2016) in the Western Cape stated that the school principal did not want to release money so that licenses for the software could be renewed. The unavailability of software was one of the main reasons why computers were not being used in the classroom. Similar findings were obtained in Ireland (Young 2016), where a study conducted to examine teachers' attitudes towards the use of tablets revealed that a lack of curriculum content prevented some teachers from using ICTs. There was a limited availability of Irish-language resources. Thus, in order to create an environment conducive to ICT integration, school principals should provide support in managing the adoption and use of ICTs in schools. It is argued that schools led by principals who support the use of technologies in the classroom are most likely to integrate ICTs faster than schools where principals are not supportive (Southworth 2005). If teachers are involved in ICT decisions before implementation, then they are more likely to accept the use of ICTs in the classroom (Anderson, Schwager & Kerns 2007).

Inadequate ICT infrastructure

Inadequate ICT infrastructure, such as a lack of enough computers, could hinder the adoption and use of ICTs at schools (Steyn & Van Greunen 2014; Francis, Ngugi & Kinzi 2017). Some schools are financially constrained and cannot afford buying computers for all learners. Funding by governmental departments is also often inadequate and this poses a challenge to schools with constrained budgets. Marcovitz (2015) argues that there are few users of the new ICTs in schools due to the fact that the technological enthusiasts are ignorant of the classroom realities, disregard the social organisation of schools, and exaggerate claims for what the technology can do. ICTs adoption in schools is affected by the context in which the technologies are implemented (Marcovitz 2015). Research findings at a junior secondary school in Cofimvaba in the Eastern Cape Province indicate that conditions were indeed not conducive for the implementation of e-learning (Steyn & Greunen 2014). The school had only a few teachers, learners from different grades are all accommodated in one classroom, and the school also had problems with electricity. Managing and maintaining discipline in such classes with students from different grades might be a challenge to teachers. A reliable electricity supply is required for the running of the computer laboratory but that was not the case at the Cofimvaba junior secondary school.

Furthermore, Chigona et al (2010) argue that inadequate computers at schools may result in only one learner being able to use a computer at a particular time. This is due to the fact that there are more learners than computers available in each class. The learning material is uploaded on a tablet, so only learners with the tablets are able to access the learning material. Concurring with Chigona et al are Albugami and Ahmed (2015) who also argue that hindrances to ICT implementation in schools include the increasing number of learners in classrooms in comparison with the limited number of computers. Research done by Chigona et al (2010) revealed that the schools sampled in the Khanya Project in Cape Town had approximately only 25 computers in the laboratory, yet most classes had between 40 and 60 students. The high learner computer ration poses a challenge to the teachers in organising computer laboratory sessions (Davids 2009). Inadequate ICT infrastructure resulted in learners sharing the computers, hence not all of them developed computer skills, as some were merely spectators. Furthermore, too few computers mean that the teachers could not fully integrate ICTs in teaching and learning. This is due to that fact that not all learners can simultaneously access course material on the computers in a lesson. The digital divide will continue deepening instead of closing due to, for instance, inadequate ICT infrastructure and limited ICT skills among some teachers and learners at some schools.

Similar impediments to the integration of ICTs in the teaching-learning process at some schools were also found in the Missionvale Township of Port Elizabeth (du Plessis & Webb 2012b). In their research, du Plessis and Webb found that there was a lack of infrastructure and resources in the schools studied. Teachers desired more computers, more internet connections and support from the Department of Education. The teachers also indicated that there was inadequate teacher participation and consultation regarding ICTs implementation at schools. It can, thus, be concluded that adequate ICT infrastructure coupled with teacher support among others is necessary for effective implementation of ICTs in teaching and learning.

Internet access

Internet connectivity is a further challenge at some schools in South Africa. This is, however, not a South African problem only. Similar tendencies were reported by Özdemir (2017). Özdemir revealed that Turkish teachers who worked at public schools in Bartin City had no access to the internet at their schools, hence they could not use ICTs. Out of the six schools surveyed by Assan and Thomas (2012) in Mafikeng, four had no internet connection. Similar findings were obtained among some Turkish teachers who work in public schools in Bartin City (Özdemir 2017). The teachers argued that there was no internet connection at school. Hence they could not use the ICTs. These findings in South Africa and Turkey concur with Beukes-Amiss and Chiware's (2006) argument that in the developing parts of the world there is inadequate access time per month for technologies to be used by both the educators and learners. Learners at schools without internet connection are, therefore, not exposed to search skills on the internet and are isolated from the information society.

Unreliable electricity provision

There are also other extrinsic barriers to ICTs implementation is schools (Jayson et al 2014). These challenges include unreliable electricity provision to enable access to ICTs. Technologies such as computers and overhead projectors require a stable electricity supply to function properly. Failure to supply electricity at some schools results in teachers abandoning e-learning.

Theft of ICTs infrastructure

Another barrier to the successful implementation of ICTs in teaching and learning is theft (Ford, Botha & Meraka 2015). This is revealed by research conducted at Sibiya High School in Rustenburg in the North West Province of South Africa. Els and Blignaut (2010) state that the Sibiya High School is situated in a poverty-stricken community where theft is high. Projectors and telephone cables were stolen and the school was, thus, disconnected from the internet, and had to rely on a satellite link to access internet service (Els & Blignaut 2010). A similar instance was reported at the Menzi Primary School in Gauteng Province, where 185 tablets, eight teachers' laptops, three desktop computers, among other things, were stolen (Ngqakamba 2019). The ICT devices were stolen just a week after the Gauteng MEC had officially opened the ICT facility at the school.

Lack of technical support

School-based technical support is important in assisting teachers whenever they need help with ICT technology (Law, Pelgrum & Plomp 2008). The Second Information and Technology in Education Study (SITES) 2006, a research about the use of ICTs in education was conducted by the International Association for the Evaluation of Educational Achievement (IEA) (Leendertz, Blignaut, Nieuwoudt, Els & Ellis 2013). The research investigated the pedagogical use of ICTs across the world, including South Africa. Teachers who participated in the study complained of a lack of ICT teachers at the schools and a lack of school based technical support for the teachers using ICTs, among other things (Law et al 2008). The unavailability of technical support resulted in some teachers abandoning ICTs whenever they faced technical challenges that they could not solve.

This is also evidenced by research done at public secondary schools participating in an e-learning project in the Western Cape. An ICT survey conducted by Ogunniyi (2016) indicates that only 8.89 per cent of the forty-five teachers from the schools selected for the study said that they received technical support and that ICTs were updated frequently. Similar findings were obtained in Quebec, Canada by Rabah (2015). The study investigated teachers' and educational consultants' perceptions of ICT integration in Québec English Schools, with regards to the benefits and challenges of ICT integration (Rabah 2015). The teachers explained that they were not getting enough technical support. For instance, they would sometimes wait for weeks before getting a light bulb for a smart board fixed by a technician.

Favourable ICT-related school conditions, such as an ICT coordinator who assists teachers with technical support and relevant pedagogics, are a necessity for the adoption and use of ICTs (Rodríguez-Miranda, Pozuelos-Estrada & León-Jariego 2014). Towers and Oliver (2000) agree that quality technical support is paramount in maintaining the confidence of teachers in the reliability of accessing computer hardware and software.

Financial constraints

The new ICTs are likely to put a heavy burden on the budgets of schools. Disadvantaged schools may be unable to afford to buy computer hardware and software and to constantly update it (Chigona 2011). This view is echoed by Assan and Thomas (2012) whose research at a number of schools in Mafikeng revealed that 89.4 per cent of the 97 teacher respondents agreed that their school did not have sufficient funds to purchase ICT tools. It can, thus, be concluded that the costs of ICTs may cause unequal educational conditions for the disadvantaged schools and learners.

Workload

The use of ICTs in the classroom requires adequate preparation (Ghavifekr, Kunjappan, Ramasamy & Anthony 2016). It is posited that about three to four hours are required to prepare for one hour of ICT- enhanced lesson (Dang 2011). Research conducted at Chinese secondary schools in Malaysia revealed that some teachers could not use technologies in teaching and learning due to high workloads (Raman & Yamat 2014). The teachers stated that they were burdened with administrative work, which included the preparation of report cards. They, thus, did not have adequate time to plan using technologies in teaching. The same teachers also did not want to integrate ICTs in their English lessons because they believed that ICTs wasted their time, and they rather concentrated on finishing the syllabi and on examinations. Similar findings were reported for some public schools in Bartin city, Turkey (Özdemir 2017). The teachers argued that preparing ICT-enhanced lessons took a lot of time. They would sometimes fail to conduct their lesson due to technical difficulties with the smart board. Hence using ICTs was believed to be a mere waste of teachers' time.

4.9.2 Second order barriers to ICT adoption

Second order barriers are intrinsic to teachers and include attitudes toward new technologies, beliefs about teaching and learning, and resistance in teachers towards new ICTs (Ertmer 1999). Some teachers who still believe in teacher-centred methods of teaching may also be reluctant to change their pedagogy to embrace ICTs in the teaching and learning process (Chigona et al 2010). Conversely, teachers who believe in learner-centred teaching and learning methodologies are more likely to integrate ICTs in their teaching.

Teachers' attitudes towards ICTs

Simply rolling out ICTs in schools does not guarantee usage (Steyn & Van Greunen 2014). Mustafina (2016) is of the view that ICT appreciation and usage is influenced by a person's attitudes. It is argued that positive attitudes towards ICTs such as the computer are associated with high levels of computer experience (Yusuf & Balogun 2011). The teacher's behaviour also has an impact on learners' confidence and attitudes towards the use of ICTs as teachers are role models to their learners. Thus, the teacher is the key to whether and how technology is used in schools. Teachers with a positive attitude towards technology are more likely willing to learn about the technologies (Hart & Laher 2015). On the other hand, teachers with a negative attitude towards ICTs are less likely to learn about the use of technology in the classroom. For instance, a study conducted at some Chinese secondary schools in Malaysia revealed that some older teachers did not want to integrate ICTs in the classroom (Raman & Yamat

2014). The teachers said that they believed in traditional methods of teaching and learning, which made learners “touch, feel and learn” (Raman & Yamat 2014). They also argued that they could make the lesson interactive without using ICTs. A lack of knowledge about technologies, therefore, automatically results in teachers not using ICTs in the teaching and learning.

Research done at disadvantaged high schools forming part of the Khanya Project in Cape Town (see section 4.8.2), revealed that some teachers felt that the introduction of technology in the classroom was a threat and had doubts about the benefits of using ICTs in teaching and learning (Chigona 2011). Such teachers will not accept technology and would rather resort to traditional teaching methods. Learners taught by such teachers might, thus, be unable to use ICTs to enhance learning. Consequently, this might mean that learners will not develop ICT skills. Limited exposure to, and use, of ICTs might perpetuate the digital divide between learners who are exposed to technology in the classroom and those who are not.

Technology might only be used in classrooms if teachers have the right attitudes and are motivated to do so. This is evidenced by research conducted by Chikasa, Ntuli and Sunderjee (2014) in Johannesburg schools, where the Gauteng Online Project was launched in 2001 to promote the use of ICTs in the classroom. The Gauteng Online Project provided school computer laboratories with twenty-five computers each, which were connected to the internet. Research conducted by Chikasa et al (2014) revealed that the computer laboratories were not used for teaching and learning purposes in most schools. The availability of ICTs in schools, thus, does not imply usage. 50.9 per cent of schools in South Africa were said to be in possession computers by 2005, but only 22.6 per cent were using the computer for teaching and learning (Chikasa et al 2014).

Positive attitudes towards the use of ICTs in teaching and learning can be developed by providing teachers with adequate technologies, such as smart boards, software for pedagogical practices and wireless printers (Ng & Nicholas 2013). On the contrary, Yuen, Law and Wong (2003) are of the view that the successful implementation of ICTs in schools is not about providing hardware and software, but motivating teachers. Furthermore, successful implementation of technology in schools is also not about acquiring ICT skills, but assisting teachers in their daily engagement with learners. Thus, the availability of ICTs at schools does not necessarily imply that teachers will adopt the technologies in the teaching and learning process.

Technophobia and fear of technology

Another intrinsic barrier to the use of ICTs in the classroom is fear of using computers (van Dijk 2008). Research conducted on disadvantaged high schools taking part in the Khanya Project in Cape Town (see section 4.8.2) revealed that some teachers were afraid to make mistakes in front of students when using ICTs and so resisted using the technologies during teaching and learning (Chigona et al 2010). Teachers who were not confident were reluctant to use computers in the classroom (Yusuf & Balogun 2011). It can, therefore, be said that schools with teachers who know the benefits of technology are more likely to be ready to adopt ICTs in the classroom. Those teachers who do not value and understand the benefits of ICTs will, on the other hand, have difficulties in adopting and using the technologies in teaching and learning.

4.10 Conclusion

The integration of ICTs in teaching and learning has modified traditional teaching methods (Njoku 2015). The use of technology in teaching has, consequently, led to new modes of teaching such as blended and fully online learning. Teaching and learning is, thus, no longer restricted to the classroom walls. Rather, it can take place anywhere and anytime (Saadatmand 2017). However, the adoption and use of ICTs in teaching and learning is faced with challenges which prevent technology implementation at some schools. The barriers to ICT use at some schools has resulted in South Africa failing to close the digital divide between schools that use ICTs and those that do not use the technologies (Dzansi & Amedzo 2014). The right quantity and quality of ICT infrastructure, ICT competent teachers, and supportive school principals are some of the crucial factors in the effective implementation of ICTs in the classroom. Failure to address the challenges related to the adoption and use of ICTs at some schools would mean widening of the existing knowledge gap and deepening of socio-economic and political disparities elucidated in the previous chapter. The adoption and use of ICTs in schools could assist in overcoming challenges of improving effectiveness and efficiency of teaching and learning, thus narrowing the digital divide (Adu 2016). ICT-related continuous professional development courses might also assist in equipping teachers with ICT skills. Thus, the next chapter is a discussion of the technological, pedagogical and content knowledge (TPACK) of teachers.

CHAPTER 5

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) FRAMEWORK

5.1 Introduction

The adoption and use of ICTs at institutions of learning has resulted in the modification of traditional methods of teaching and learning (Eyles 2018). The previous chapter focused on the role of ICTs in education as well as the potential benefits of the technologies and barriers associated with the implementation of ICTs at institutions of learning. This chapter focuses on the technological pedagogical content knowledge (TPACK) framework by Mishra and Koehler (2006).

5.2. Technological pedagogical content knowledge (TPACK) framework

TPACK is a term that describes what must be known by teachers to effectively integrate technology in teaching and learning (Koehler & Mishra 2008). It is an interrelation of teacher content knowledge, pedagogical knowledge and technology knowledge, as well as the contextual factors (Harris & Hofer 2011).

TPACK is also viewed as an extension of Shulman’s (1986) pedagogy content knowledge (PCK) (Wilkin, Rubino, Zell & Shelton 2013). Shulman posited that for teachers to effectively teach, they need to know the methodologies that best suit learners and integrate the methodologies with the content of a particular subject. The teacher’s knowledge on how to blend pedagogy and knowledge is what Shulman terms the pedagogy content knowledge (PCK).

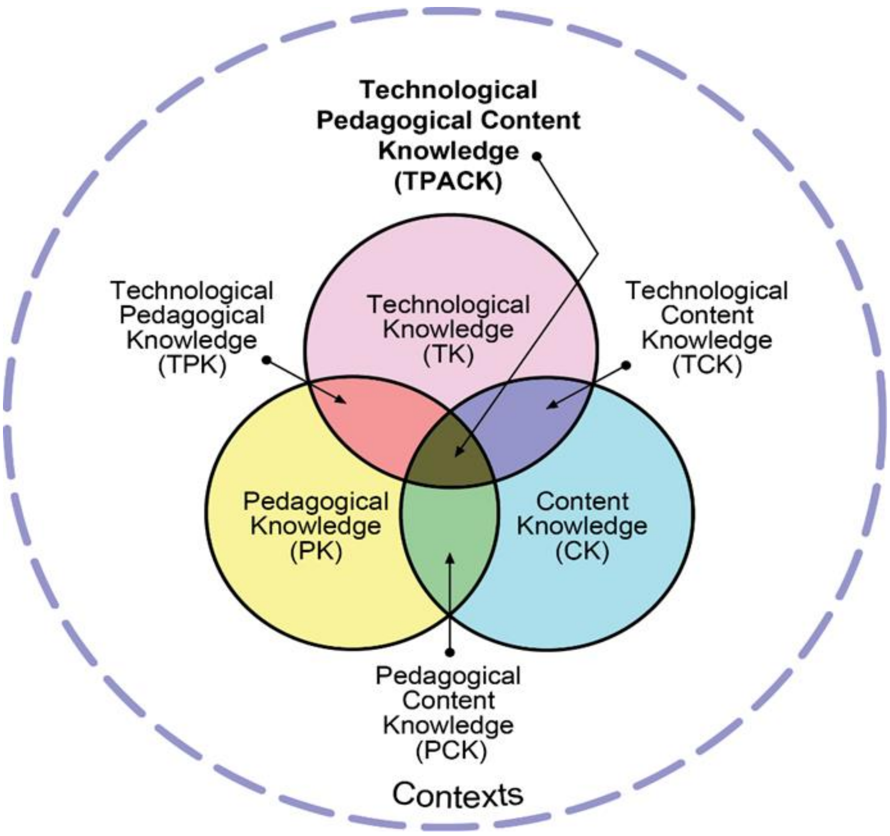
Shulman’s work was extended by Mishra and Koehler (2006). Mishra and Koehler integrate technology as an additional element to pedagogy and content knowledge. Technological pedagogical content knowledge, thus, represents an interplay between technology, pedagogy and content knowledge (Wilkin et al 2013). These three - technology, pedagogy and content knowledge (TPACK) -

form a unified whole for assisting educators to benefit from using technology to develop student learning (Jaipal & Figg 2010).

Furthermore, it is postulated that TPACK is a “temporary construct’ (Botha Brantley-Dias & Ertmer 2013) that will be needed only until classroom technology use becomes ubiquitous. The TPACK construct is needed to focus attention on the intersection between technology and pedagogical content knowledge. However, as ICTs become more abundant, TPACK becomes embedded within content knowledge (CK), pedagogy knowledge (PK) and pedagogy and content knowledge (PCK). In other words, as ICTs become ubiquitous in the education sector, the knowledge of how to use technology could simply dissolve into pedagogy and content knowledge (PCK) (Cox & Graham 2009). Therefore, rather than being a separate knowledge category, technological pedagogical content knowledge (TPACK) will be part of the category of pedagogical and content knowledge (PCK).

If technology knowledge is placed within pedagogical content knowledge (PCK), it takes the focus off the technology and places it within the teaching and learning domain (Neiss 2005; Mishra & Koehler 2006; Mishra 2011; Brantley-Dias & Ertmer 2013). Mishra and Koehler argue that the current TPACK unintentionally places heavy emphasis on the technology aspect of the construct, even though it is not the intent. Technology tools support pedagogical content knowledge. Therefore, emphasis should be placed on pedagogical content knowledge (PCK).

Figure 5. 1: The TPACK framework and its knowledge components.



Source: http://tpack.org

A description of each knowledge domain follows:

5.2.1 Content knowledge (CK)

Content knowledge in teaching is described as a teacher's curricular content knowledge (Shulman 1986). It entails knowledge of instructional resources that are suitable for teaching a certain content, including resources such as software and visual materials (Brantley-Dias & Ertmer 2013). Drawing from Shulman's description, content knowledge refers to the teacher's subject matter knowledge to be taught to students and the ability to identify learning outcomes of that particular subject (Koehler & Mishra 2009). An in-depth understanding of the knowledge fundamentals of the subject content is of great importance if teachers are to deliver correct information to students.

5.2.2 Pedagogical knowledge (PK)

Pedagogical knowledge pertains to knowledge of teaching and learning methodologies (Habowski & Mouza 2014). It encompasses knowing how students learn, understanding differences in learners' cognitive abilities, classroom management, lesson planning and various types and methods of assessment (Koehler & Mishra 2009). A teacher with pedagogical knowledge also understands the target audience, their age group, cognitive abilities, how the students obtain skills, and create knowledge.

5.2.3 Technological knowledge (TK)

Technological knowledge refers to a person's understanding of how to effectively apply technology, such as the internet and software programmes, to their daily lives and at work (Koehler & Mishra 2008). These technologies include hardware such as interactive whiteboards, overhead projectors, routers, computers, tablets and software such as the internet, Microsoft Excel and Microsoft Word (Koehler & Mishra 2009). Through understanding how to use hardware and software programmes, teachers could then be able to effectively use the ICTs in teaching and assessing learners in a way that enhances learners' comprehension of the subject matter. Technological knowledge also refers to an individual's ability to recognise when information technology can be helpful in achieving a particular goal or when it can be an impediment. A mastery of ICT skills and how to meaningfully apply them in everyday life is also a necessity, thus technological knowledge (TK) goes further than traditional concepts of computer literacy. Technology is not static; it, thus, requires an individual who can adjust to new developments in ICTs and software.

5.2.4 Technological pedagogical knowledge (TPK)

Technological pedagogical knowledge is the ability to understand how particular ICTs impact the way students learn and teachers teach (Koehler & Mishra 2009). It therefore requires effective use of technologies in planning and implementing lessons so that the subject matter objectives are achieved. It is a practical teaching competency (Jaipal & Figg 2010). Teachers can build technological pedagogical knowledge (TPK) through deeply understanding the limitations and opportunities of ICTs.

5.2.5 Technological content knowledge (TCK)

Technological content knowledge (TCK) is defined as the way "in which technology and content impact each other" (Koehler & Mishra 2008:16). Teachers do not only need to master the subject matter, but also understand the way in which the subject content can be altered by the use of ICTs. Furthermore, Jaipal and Figg (2010) argue that technological content knowledge (TCK) is the teacher's ability to match the technology tools to the subject matter in order to attain specific learning goals. Therefore, teachers need to know technologies which best suit certain subject content and how technology can change the subject matter, or vice versa (Koehler & Mishra 2008).

5.2.6 Pedagogical content knowledge (PCK)

Pedagogical content knowledge refers knowing how to integrate appropriate pedagogical approaches that are suitable for the teaching of specific subject content (Koehler & Mishra 2008). It also includes the teacher's ability to select pedagogy which suits students' abilities so that they master the particular subject matter. Pedagogical content knowledge covers methods of teaching, learning and assessment for a particular subject matter (Jaipal & Figg 2010). Only developing pedagogy content knowledge (PCK) is inadequate for teachers to successfully teach with technology (Koehler & Mishra 2013). Rather, pedagogical content knowledge should become part of the knowledge required by educators to integrate ICTs in teaching. Furthermore, if the pedagogy content knowledge (PCK) required for each subject differs, it then follows that the ways in which ICTs might be used for each subject may also differ (Bull & Bell 2009). Thus, a number of different content variations such as Geography-TPACK and English-TPACK were proposed (Brantley-Dias & Ertmer 2013). Bull and Bell (2009) argue that these TPACK variations draw attention to the need to understand the pedagogically comprehensive ways in which ICTs can support teachers' and learners' subject-based work.

5.3 TPACK levels of teachers

ICTs provide teachers with opportunities to assist in their teaching practices. Teachers need to design lessons that equip learners with 21st century skills, such as critical thinking, problem-solving and technology skills. However, research on teachers' ICT lesson approaches shows them to be mainly using ICTs to transmit information to students (Koh, Chai, Hong & Tsai 2015). Hence studies have been conducted to determine the TPACK levels of teachers.

5.3.1 TPACK levels of teachers

The Second Information and Technology in Education Study (SITES) 2006, a research about ICTs use in education, was conducted by the International Association for the Evaluation of Educational Achievement (IEA) (Leendertz et al 2013). The study investigated the pedagogical use of ICTs across the world. South Africa performed poorly in the use of ICTs in teaching (Law & Chow 2008). South Africa poorly performed despite an increase in ICT infrastructure in schools. In 1999, 12.3 per cent of schools in South Africa had ICT infrastructure (Department of Education 2004) and it rose to 38 per cent in 2007 (Department of Education 2007). It can, therefore, deduced that merely introducing ICTs at schools does not ensure effective use of the technology for teaching and learning. Teachers should be competent in all the components of the TPACK framework so that they are able to integrate ICTs into their pedagogical practices (Mishra & Koehler 2006).

Out of 640 Mathematics teachers in South Africa who completed the SITES 2006 questionnaire, 222 teachers knew the learning situations suitable for ICT use (Blignaut et al 2010). However, 73 out of the 222 teachers were not sure if they had adequate knowledge and skills to integrate ICTs in their lessons, while 390 teachers did not know the situations to incorporate ICTs in teaching. This is contrary to the TPACK framework, which holds that an ideal teacher should be able to integrate knowledge of ICTs, the subject content and pedagogy. Such a teacher also knows teaching and learning situations in which ICTs are suitable. On the other hand, teachers with inadequate knowledge and skills regarding TPACK are most likely to abandon e-learning.

It can also be argued that the findings by Blignaut et al (2010), that South African teachers performed badly in the use of ICTs in teaching, could be ascribed to the nature of the ICT related professional development courses presented to some teachers. ICT training has been generic and did not assist teachers in learning content specific ways of integrating technology (Ziphorah 2014). Teachers teach different subjects and need to be trained on how to teach particular subject content using ICTs. Koehler and Mishra (2013) also argued that there is no “one size fits all”.

Further analysis of the SITES 2006 data was done by Howie and Blignaut (national research coordinators of SITES 2006 for South Africa) (Plomp & Voogt 2009). Howie and Blignaut analysed the readiness of South African teachers’ to integrate ICTs into Mathematics and Science pedagogy in secondary schools. They concluded that fewer than 20 per cent of the teachers used ICTs in teaching Mathematics and Science. Concurring with these findings are Law and Chow (2008) who argue that, although many teachers acknowledge the value of integrating ICTs in their lessons, pedagogical use of the ICTs in South African schools remains dismally low. The few teachers who were using ICTs in teaching Mathematics acknowledged observing a positive change in their learners’ knowledge and skills when they started using ICTs in their lessons. However, some indicated that ICTs had no impact on learners’ Mathematics skills (Leendertz et al 2013).

Law and Chow’s 2008 findings are confirmed by the findings of a study by Govender and Maharaj [sa] in the EThekwini municipality in KwaZulu-Natal. Govender and Maharaj found that teachers were positive about the uses of technology, but they lacked ICT skills to adopt and use the technology in teaching and learning. The study revealed that technological proficiency was very low, especially amongst the black African teachers and at schools situated in disadvantaged communities. Teachers were mainly using computers to teach subjects such as Computer Studies. This is an indication that some teachers serving in low-income areas lacked technology pedagogical knowledge to implement ICTs in teaching and learning. Limited ICT skills among black African teachers in EThekwini could be due to the fact that most teachers are digital immigrants who might never have been exposed to ICTs in education before the professional development courses were presented at schools.

It can also be argued that although ICTs are available to some teachers, their level of competency regarding the various components of TPACK did not improve (Leendertz et al 2013). Thus, there are other factors than ICT skills, which are preventing the use of ICTs. These include inadequate ICT training and teachers' attitudes towards technology. It is also postulated that a lack of confidence among teachers who have limited TPACK knowledge hinders them from using ICTs in teaching. Daly, Pachler & Pelletier (2010) hold the opinion that continuous exposure to meaningful professional teacher development in TPACK might improve teachers' confidence to explore ICTs resources.

The development of the teachers' TPACK would ensure ICT integration required by the e-learning White Paper (Department of education 2004; Mishra & Koehler 2006). Abuhmaid (2011) is of the view that an evaluation of teachers' developmental courses should be done in order to find out if teachers of particular subjects are practically taught how to integrate ICTs in their respective subject content. This view concurs with a study of ICT teacher training in Nigeria (Olakulehin 2007). Olakulehin identified a lack of practical exposure to ICTs as a hindrance to ICT integration in the classroom. This study also emphasised that ICT professional development courses play an important complimentary role in teaching. Technology-related professional development plays a role in assisting to bridge the gap in knowledge and skills among some teachers.

Research conducted by PanAf (2008-2011) at ten South African public schools revealed that most teachers attended ICT training, but the courses constitute basic computer skills. Most of the teachers' technological proficiency was very low and they could only use computers for writing lesson plans and tests for their students. However, findings obtained by PanAf in South Africa differed from Alenezi's (2015) findings in Saudi Arabia. Alenezi conducted research at some Saudi schools participating in the Twateer Project to investigate how ICTs, the smart board in particular, were being used in teaching and learning. The Saudi teachers were faced with the reality of gradually shifting from traditional methods of teaching to technologically oriented ones, hence the King Abdullah Bin Abdulaziz Project (Twateer). The project was meant to support teachers in their integration of ICTs in teaching. Teachers used the smart board for presentation purposes, that is, power-point presentation, selecting pages from learners' e-books and PDF files. They also benefitted from the affordances of a smart board such as presenting the same lesson conducted in previous classes, hence they did not have to re-write lesson plans. Some Saudi Mathematics teachers revealed that using a smart board reduced the time that they spent writing notes and drawing pictures on the board which, in turn, helped in increasing learners' understanding of concepts being taught.

Research to explore competencies regarding the TPACK framework of Taiwanese secondary school Science teachers was also conducted by Jang and Tsai (2013). The results indicated that secondary Science teachers' TPACK competencies correlated statistically significantly with their teaching experience. Experienced Science teachers had significantly higher content knowledge (CK) and pedagogical content knowledge (PCK) competencies than novice Science teachers. It can, therefore, be argued that teachers develop their content and pedagogical knowledge as they teach. The more the number of years of teaching experience, the more CK and PCK are developed.

However, the less experienced Taiwanese Science teachers tended to rate their technology knowledge and technological content knowledge (TCK) in context significantly higher than did the more experienced teachers (Jang & Tsai 2013). This could be due to more confidence in their knowledge of subject matter and methodologies. However, these findings of the Taiwan study contradict those of a South African study conducted by Chigona (2015). In South Africa, it was found out that most of the newly qualified teachers were not able to deliver the curriculum using the new technologies.

The experienced teachers in Taiwanese schools were, however, less confident in ICT knowledge itself, including its relation to content knowledge (CK) and pedagogical content knowledge (PCK) (Jang & Tsai 2013). The less experienced teachers were young and tended to be keener to learn about ICTs and how to integrate technology into their teaching. The more experienced teachers may have been teaching within the traditional mode and were satisfied with that methodology. Thus, they might not find it necessary to develop ICT skills and the knowledge of using technology in teaching and learning. However, the teachers still have the potential to develop ICT skills to effectively integrate technology with content knowledge (CK) and pedagogical content knowledge (PCK) in Science teaching. The less experienced teachers, on the other, hand may still be developing their content and pedagogical knowledge.

The TPACK competencies of teachers may, thus, vary (Keser, Yılmaz & Yılmaz 2015). Some teachers were not exposed to ICTs use during their teacher training course at colleges and universities. Others, especially the novice teachers, have some ICT skills obtained at universities. Thus, ICTs training skills are a necessity if all teachers are to meaningfully use technology in teaching and learning.

5.3.2 Pedagogical content knowledge levels of teachers

Pedagogical content knowledge (PCK) comprises two main elements, namely, teachers' representation of the content knowledge (CK) and the knowledge about the problems faced by learners while learning a particular topic in the content (Shing, Mohd, Saat & Loke 2015). A teacher with content knowledge (CK) is capable of presenting the subject content in a form suited to the diverse abilities and interests of students (Shulman 1987). Such teachers are able to plan lessons with suitable approaches that result in learners' conceptual understanding. Appropriately planned lessons consider students' characteristics, such as diverse backgrounds and prior knowledge (Yusof & Zakaria 2015).

The pedagogical content knowledge (PCK) levels of teachers have an impact on how teachers integrate pedagogical approaches that are suitable for the teaching of specific subject content (Koehler & Mishra 2008). Research comparing the PCK levels of some secondary school Technology teachers was conducted in South Africa and New Zealand (Williams & Gumbo 2012). The study revealed contrasting findings for South African and New Zealand teachers. In New Zealand, Technology education was skills-oriented, whereas in the South African context, teachers heavily relied on textbooks. Teachers in South Africa recognised the importance of engaging students in practical work. However, limited resources hindered the South African teachers from actively involving students in Technology education, hence heavy reliance on textbooks.

Heavily relying on textbooks could also be the result of limited content knowledge of the subject matter (Ramnarain & Fortus 2013). Ramnarain and Fortus conducted a study in the Gauteng Province, on teachers' content knowledge (CK) and pedagogical content knowledge (PCK) competencies with regard to the curriculum for Physical Sciences in some secondary schools. The findings revealed that despite the fact that some teachers had acquired knowledge in the new developments in Physical Sciences during their undergraduate studies, the teachers had difficulty in understanding topics with new concepts, such as electronics and the electron microscope. A lack of understanding of new concepts could be a result of not regularly accessing the acquired knowledge and using it in lesson planning (Arzi & White 2008). This, consequently, compromised teachers' pedagogical content knowledge (PCK) (Ramnarain & Fortus 2013). Teachers with limited content knowledge (CK) resorted to the textbook and avoided class discussions. Thus, teachers' content knowledge (CK) has an influence on their pedagogical content knowledge (PCK). Effective teaching involves knowledge of content and an understanding of various methods of representing such knowledge so that students understand it (Botha & Reddy 2011).

5.3.3 Content knowledge levels of some teachers

Visser, Juan and Feza's (2015) study at some schools in South Africa revealed varying levels of content knowledge (CK) among teachers. This could be due to the fact that well-resourced schools attract better qualified teachers, whereas teachers at poor, dysfunctional schools are poorly qualified (Visser, Juan & Feza 2015).

Anyanwu, Le Grange and Beets (2015) conducted a study in secondary schools in the Western Cape Province regarding the content knowledge of Geography teachers on climate change Science. They found out that the majority of the participants had high literacy levels in Climate Science. However, there were some gaps in the teachers' content knowledge (CK) competencies of some aspects of Climate Science. For instance, some teachers were not aware that water vapour is the most abundant greenhouse gas. It is, therefore, advisable that teachers and school managers consider the implementation of continuous professional development courses that will allow teachers to understand new developments within their disciplines. This will enable the teachers to teach learners climate change effectively.

On the contrary, continuous professional development programmes for teachers in South Africa have had a little impact on student throughput levels (Pournara, Hodgen, Adle & Pillay 2015). For instance, the results of the summative national and international assessments, such as the Trends in International Mathematics and Science Study (TIMSS), the Annual National Assessments (ANA), and the National Senior Certificate (NSC) examinations, revealed that most teachers in South Africa have low levels of Mathematics content knowledge (CK). This is despite several years of professional development in Mathematics (Pournara, Hodgen, Adle & Pillay 2015). The poor content knowledge negatively impacts the learners that they taught. Pournara et al further revealed that many of the teachers teaching Mathematics at lower secondary school level had little and/or no training at all to teach the subject. This results in learners' poor performance at Mathematics. South Africa is, thus, ranked second from the bottom of the international league table of 25 countries in terms of Mathematics performance

(Roberts 2017). It is posited that some universities in South Africa and the National Research Fund Numeracy/Mathematics chairs are developing and refining some developmental Mathematics courses for teachers (Roberts 2017). This is being done in a bid to improve content knowledge (CK) of Mathematics teachers. It can be argued that teachers might be unable to teach effectively using ICTs if they have inadequate content knowledge competencies.

A content gap among some teachers was revealed by a study conducted in the North West province by Quan-Baffour and Arko-Achemfuor (2009)**.** Quan-Baffour and Arko-Achemfuor revealed that Accounting, Business Economics and Management teachers at some rural schools had limited content knowledge and pedagogy of their particular subjects. It is argued that some of those teachers were trained at ill-resourced colleges. Moreover, the curriculum had also changed and the teachers were not formally trained in the new National Curriculum Statement (NCS) curriculum. The teachers might, thus, be struggling to teach the subject content. It therefore follows that such a scenario could impede effective teaching and learning. Short courses that the teachers were afforded proved to be ineffective since most of the teachers revealed that they were not competent enough to teach the new topics. Furthermore, they had never done some of the new topics during their teacher training courses, hence could not teach effectively (Quan-Baffour & Arko-Achemfuor 2009). Continuous professional development of teachers in content knowledge (CK) is, therefore, a necessity.

5.4 How the TPACK framework informs teaching and learning in schools

The technological pedagogical and content knowledge (TPACK) framework provides a mirror through which to view teachers' ICT skills in teaching and learning. The teachers' digital skills are important for the effective integration of ICTs in teaching. Technological pedagogical content knowledge (TPACK) is characterised by intersections of the teachers' content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), technological pedagogical knowledge (TPK) and technological content knowledge (TCK) (Koehler & Mishra 2008). All these domains are required for effective technology integration in teaching and learning. TPACK affords a holistic approach to ICT integration in the classroom (Jaipal & Figg 2010).

The TPACK framework, thus, captures important issues related to the application of ICTs in teaching. It is not only about knowing how to use ICTs in teaching, but also about knowing how best to do that using the methodologies and content that teachers already have.

5.4.1 Technology pedagogy and content knowledge

TPACK deals extensively with the knowledge domains, technology, pedagogy and content knowledge (Koehler & Mishra 2008). This framework can also be used to point to the importance of digital competencies among teachers. It is argued that teachers are at different TPACK level competencies in the course of their teaching with technology (Niess, Sadri & Lee 2009). Niess et al state that TPACK levels are recognising, accepting, adapting, exploring and advancing. Teachers who rarely integrate ICTs in their teaching are at the recognition level. Such teachers consider ICTs as low level tools for learning subject content. The teachers recognise the alignment of technology with subject content but do not integrate ICTs in teaching and learning. Teachers who are not consistent in using technology are at the acceptance level. Such teachers form a favourable or unfavourable attitude towards the use of ICTs in teaching and learning (Niess, Ronau, Shafer, Driskell, Harper, Johnston, Browning, Özgün-Koca & Kersaint 2009).

Some teachers are at the adaption level (Neiss, Driskell & Hollenbrands 2016). These teachers integrate ICTs in teaching, but the activities in which they engage learners involve low level thinking activities which are teacher-directed. Research conducted by Niess, van Zee and Gillow-Wiles (2011) revealed that teachers at the adaption level are concerned about meeting curricular requirements. Teachers that allow learners to explore subject matter by means of ICTs are at the exploration level. Such teachers teach through learner-centred methodologies and actively engage learners in class activities and beyond the classroom. Niess et al further argue that teachers at the adaption and exploration levels provide learners with opportunities to work with ICTs and that enable learners to have strong conceptual understanding of the content. Conceptual understanding refers to the learner's ability to comprehend subject matter concepts (Chadwick 2009). Learners are able to grasp ideas in a transferrable way and apply it across domains.

5.4.2 Contextual factors

It is postulated that teachers are confronted with different content, different ICTs, different learners and different contexts within which they use technology (Niess et al 2010). The harmonisation of the relationship between humans and technology is termed information ecology (Thapa & Sein 2018). Information ecology comprises four basic elements which are people, practices, values and technologies (Nardi & O'Day 1998).

The TPACK framework emphasises the role of context when teaching and learning take place. Various contextual factors - from the institutional to the personal - affect how teachers enact the TPACK (Chai, Koh & Tsai 2011; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur 2012; Swallow & Olofson 2017). Concurring with this view are Chai, Koh and Tsai (2013), who identified four interdependent contextual factors that they understood had an important influence on the TPACK framework. These are the intrapersonal dimension that relates to the pedagogical beliefs of the teacher, the interactions between the students, the school and class environment and the provision of technology for the teacher and student. The knowledge domains that form the TPACK framework are, thus, embedded within and influenced by various contextual factors.

For effective ICT integration, it is crucial for teachers to understand the relationship among the domains and the contexts in which they are formed and co-exist (Chai, Koh & Tsai 2011). It is argued that teaching and learning is most effective when content is framed within the context that learners can relate to. Teachers who understand the context in which they teach can appropriately develop context-specific approaches that are suitable for learners (Koehler &

Mishra 2009). It can be concluded that the four interdependent contextual factors identified by Chai, Koh and Tsai can either hinder or enable the adoption and use of ICTs in teaching and learning (internal and external barriers that thwart the enactment of TPACK at some schools) (see section 4.9).

5.4.3 Technological pedagogical and content knowledge

The TPACK framework forms the base for effective teaching using technology (Koehler & Mishra 2006). A teacher requires knowledge of how to represent concepts using technologies, but the reality is that some teachers are inadequately trained to use ICTs in teaching (Lyublinskaya & Tournaki 2014). Therefore, they use technology less frequently or use it to merely transmit information to learners. Therefore, adopting learning approaches which actively involve teachers in designing lessons to develop TPACK is a necessity.

Despite the discussed advantages of TPACK, the framework also has shortfalls.

5.5 Limitations of the TPACK Framework

The TPACK framework dominates approaches to understanding teacher knowledge and technology integration. Several limitations are, however, often noted in the literature (Koehler, Mishra, Kereluik, Shin & Graham 2014). It can be argued that knowledge of the different components of the TPACK framework does not necessary mean implementation of ICTs in teaching and learning. The implementation of technology in the classroom is multi-faceted. There are other factors, such as the availability of ICT infrastructure at schools and the learners' digital skills, which affect the implementation of technology in the classroom. If all factors which affect ICT adoption and use are not addressed, then implementing technology in teaching and learning might be impossible.

It is further posited that the TPACK framework implies that, for instance, any content can fit into the framework and that it will have relationships to pedagogy and technology (Kereluik, Mishra & Koehler 2010). The framework offers scanty guidance about the content to teach, which methodologies to use and the kinds of technologies to use. Thus, TPACK falls short of assisting teachers to know which content to teach in relation to specific technology and methodologies. Some teachers need assistance in assessing and selecting appropriate technology to integrate into their teaching. The TPACK framework does not assist teachers in knowing which technology to teach specific content.

The TPACK framework is further criticised for failing to capture the lived complexities of schools (Brantley-Dias & Ertmer 2013). The framework neglects taking into account classroom realities and changes in schools which affect the adoption and use of ICTs. Classroom realities include large numbers of students and few ICTs to use during teaching and learning.

The TPACK framework is also relatively static. It does not change over time and would be ineffective in a world where traditional technologies such as chalkboards and paper are available (Kereluik et al 2010). Furthermore, some schools still rely on traditional teaching methods due to, for instance, the unavailability of ICT infrastructure. Therefore, the technological knowledge (TK) component of TPACK is irrelevant in such schools.

It is further postulated that introducing technological, pedagogical and content knowledge (TPACK) complicates teaching (Koehler & Mishra 2008). Teaching with technology is referred to as a “wicked problem” due to the protean and unstable nature of the new technologies. Each ICT tool has unique propensities, potentials, affordance, and constraints (Rittel & Webber 1973). This is in contrast with traditional technology, such as the chalkboard and flipcharts. The traditional technology is characterised by specificity, stability, and transparency of function. The new ICTs disrupt the status quo and require teachers to reconfigure their understanding of technology, pedagogy and content (Mishra & Koehler 2006). Learning how to integrate ICTs in teaching and learning is, therefore, more complex than teaching with traditional technology.

Furthermore, it is argued that teachers need to understand the contexts in which they can use ICTs during the teaching and learning process. In this regard, it is posited that researchers conducting research into the application of TPACK have provided insufficient knowledge about teachers’ backgrounds and culture when they examined teachers' use of ICTs in the classroom (Adams 2017). Thus, there is a critical gap in the TPACK model when understanding technological and pedagogical practices specifically in particular cultural contexts.

5.6 Conclusion

The TPACK model requires a teacher to use methodologies that employ ICTs in practical ways to teach content since learners are active participants in teaching and learning. Teachers who develop TPACK competencies are also able to design learning activities which suit learning contexts and learners' needs and preferences. Teachers with high levels of TPACK are believed to adopt and use ICTs in teaching and learning. TPACK, however, depends upon the availability of resources such as time, ICT infrastructure and electricity among other things. Teachers should be exposed to continuous professional development courses. These courses might improve TPACK competencies of some teachers. The next chapter is thus a discussion of the research methodology for this study.

CHAPTER 6

RESEARCH METHODOLOGY

6.1 Introduction

The previous chapters explained the technological, pedagogical and content knowledge (TPACK) framework, the information society and the digital divide theories which informed the choice of the research design for this study. The literature described in the preceding chapters revealed that the information society is not equally spread in Africa, hence the existence of a digital divide between African countries, in particular, and developing parts of the world (Cheneau-Loquay 2007). Previous studies revealed that South Africa is not spared from issues related to the digital divide, as it is an unequal society with certain individuals having sufficient ICT resources, while others have restricted access to ICTs (Sikhakhane, Lubbe & Klopper 2005; Fuchs & Horak 2008; Oyedemi 2009). Information and communication technologies can be used in teaching and learning. Using ICTs in education is seen as a means of improving access, efficiency and quality of learning by facilitating access to resources and services (Agbo 2015). This research study aims to ascertain teachers' access to ICTs at schools and determine whether they have necessary skills to use ICTs effectively in teaching and learning.

This chapter is therefore presents the context of the study, research paradigm, mixed method design and the ethical considerations. The context of the study, data collection instruments, data collection procedures, data analysis, data trustworthiness, and ethical considerations that guided this study are also described. Population and sampling procedures used in this study are highlighted.

6.2 Context of the study

This study was situated in the Emfuleni Local Municipality, which forms part of the Sedibeng District Municipality, which comprises Emfuleni, Lesedi and Midvaal

Local Municipalities. The Sedibeng District Municipality lies at the southern tip of the city of Johannesburg, in the Gauteng Province of South Africa. I decided to conduct the study in Emfuleni Local Municipality because I am familiar with this municipality, which made it easier for me to conduct my study. The Emfuleni Municipality has 45 secondary schools, with a total of 45 school principals, and 940 secondary teachers including heads of departments and deputy heads. This study focused on three secondary schools located in the Emfuleni Local Municipality.

The selection of the schools was done in co-operation with the Sedibeng West District Department of Education officials. They identified schools in the Emfuleni Local Municipality which had computer laboratories and/or tablets, the internet, as well as smart boards. I selected three schools from the list which the Education official indicated that they met the criteria, and were in close vicinity. However, the situation that I encountered at the schools was quite different. Conducting the study at schools in the same local municipality cut travelling expenses for me. I also visited the selected three schools in December 2017 to make arrangements for conducting research early in 2018.

The target population for this study comprises the three school principals, and 150 teachers from the three selected schools.

6.2.1 School Profiles

The most important characteristics of the three schools are as follows:

School A

At the time the study was conducted, School A had 50 teachers which included the school principal and two deputy heads. There were 1 431 learners at the school. School A is located in Evaton and falls under quantile 1 schools. Quantile 1 schools are situated in the poorest communities. I gathered from the school principal that the school was a no-fee paying school. Learners were provided with meals at the school since they were from poor families.

I visited the Gauteng online laboratory at the school. There was one printer but it was not working. The laboratory used to have 25 computers and I was informed that they were all stolen. There were two overhead projectors for the entire school. The school had a total number of 13 smart boards, of which seven smart boards were in Grade Eleven classrooms and six were in Grade Twelve classrooms. However, there was only one smart board functioning on the first day that I visited the school. I, however, learnt that this smart board had also stopped working on my second visit to the school. There was only one internet connection point at the administration block at the school. I also found out that tablets had not yet been given to the learners by the Gauteng Department of Education (DoE) at the time when I conducted this study.

School B

At the time when this study was conducted, School B had 40 teachers, who included the school principal and two deputy heads. School B is located in Evaton West. The school had 1 368 learners. I gathered from the school principal that the school was also a no-fee paying school and also falls under quantile 1 as the majority of the learners were from poor communities. Similar to School A, learners were also provided with meals at the school.

I also visited the school's Gauteng online laboratory. The laboratory used to have 25 computers which were connected to the internet, but they were all stolen. There used to be an MTN ICT laboratory at the school, which had 25 computers, but they were also stolen. At the time of my first visit, there were two overhead projectors for the entire school. The school had a total number of ten smart boards of which five were in Grade Eleven and five were in Grade Twelve classrooms. Only one smart board had a router which was connected to the internet. The rest of the smart boards had no internet connection, because the routers were stolen. There was only one internet connection point at the administration block. Similar to the situation at School A, I also found out that tablets had not yet been given to the learners by the Gauteng Department of Education (DoE) at the time that I conducted my study.

School C

At the time when this study was conducted, School C had 60 teachers, who included the school principal and two deputy heads. There were 1 481 learners at the school who were - as in the other two schools - from disadvantaged communities. School C was also located in Evaton West and falls under quantile 1 schools. I gathered from the school principal that the school is also a no-fee paying school where learners are also provided with meals at the school.

As was the case for the other two schools, I visited the Gauteng online laboratory attached to School C. There was only one printer available and it was not working. The laboratory had 25 computers which were all disconnected from the internet and were all not working. I visited a second ICT laboratory which was empty. I was informed by the deputy head that all 25 computers in this laboratory were removed and were being kept in a safe place. The deputy head explained that theft was rampant, thus the computers were kept in a safe place. There were two overhead projectors for the entire school. The school had a total number of ten smart boards in Grade Eleven and Twelve classrooms. Four Grade Eleven classrooms had functional smart boards and the other three Grade Eleven classrooms did not have. Four Grade Twelve classrooms had functional smart boards. One class had a smart board which was not working. The other Grade Twelve classroom did not have a smart board installed. I was informed that a smart board was available for this classroom, but had yet to be installed. Similar to the other schools, there was only an internet connection point at the administration block. I also found out that tablets had not yet been given to the learners by the Department of Education (DoE) at the time that I conducted this study.

6.3 Research paradigm

Mertens (2010) states that a research paradigm directly influences the way in which a study will be conducted. The term “paradigm” is derived from the Greek word *paradeigma* which means an outline that is used to signify a theoretical framework shared by researchers (Gill 2012). Wahyuni (2012) describes a research paradigm as a set of important expectations and beliefs as to how the world is understood. A research paradigm has an impact on how an individual undertakes a social study. In the same vein, Ticehurst and Veal (2002) explain that a research paradigm provides guiding principles for the researcher to follow. A research paradigm, thus, influences the research methods to be used in a study, especially in terms of reasons for collection of certain data, the data to be collected, the context in which data is collected, the data collection methods and the data analyses strategies (Harrits 2011).

This study employed a pragmatist paradigm. The term pragmatism is derived from the Greek word *pragma* (meaning deed, work or act) (Singh 2007). Pragmatism derives from the work of Peirce, James, Mead, and Dewey (Creswell 2014). Pragmatism is defined as a philosophy which permits the researcher to study any issue of interest in ways deemed suitable and to use the research findings in constructive ways (Teddlie & Tashakkori 2009).

The pragmatist paradigm signifies "practicality, compromise, prudence and a clear goal orientation in dealing with problems" (Kalolo 2015:155). It is an action-oriented paradigm aimed at finding solutions to existing problems. Pragmatism embraces the notion of plural and dynamic realities (multiple truths). The paradigm offers an approach grounded in the emerging conversation that supports a diversity of viewpoints about the phenomena under study (Creswell 2003; Rosamond 2007). Pragmatists, therefore, do not believe in any pre-conceived, final, fixed and immutable strategies to doing research (Patton 2002; Johnson & Onwuegbuzie 2004; Morgan 2007). Rather, pragmatism is characterised by its ability to accept all well-constructed paradigms of scientific inquiry as valid when they are appropriate (Kalolo 2015). The paradigm, thus, provides for the use of both qualitative and quantitative research methodologies to collect information and make inquiry into complex phenomena of social and natural contexts (Creswell 2009; Teddlie & Tashakkori 2010).

Other paradigms, unlike pragmatism, lead researchers to either follow quantitative or qualitative research methodologies. Paradigms such as positivist and constructivist paradigms have weaknesses that constrain the researchers. The positivist philosophical approach describes and explains the features of reality through collecting data on observable sample behaviours, leading to quantitative research (Henning, van Rensburg & Smit 2004; Chilisa 2012). On the other hand, the constructivist paradigm leads the researcher into finding out meanings and explanations of phenomena by studying cases thoroughly in their natural setting, leading to qualitative research (Henning, van Rensburg & Smit 2004; Mertens 2010; Creswell & Plano Clark 2011; Ponterotto, Mathew & Raughley 2013). Pragmatism frees the researcher from these constraints imposed by the differences between positivism and constructivism (Creswell & Plano Clark 2011:27). Pragmatists are, therefore, attracted by the idea of democracy where researchers are left free to choose a methodological path that suits a specific problem in the discovery and extension of knowledge (Kalolo 2015).

Pragmatism aims at creating useful knowledge by addressing the pressing issues, contemporary problems and transferring acquired knowledge into action (Kalolo 2015). The pragmatic approach supports the connection between knowledge, experience and practice. To pragmatists, scientific knowledge is useful when it helps people to better cope with the world or to create better organizations (Wicks & Freeman 1998).

Pragmatism was selected as a paradigm for this study due to several reasons. Pragmatism allow researchers to use two approaches, qualitative and quantitative. This research study was able to address research questions that do not wholly fit into either the quantitative or the qualitative approach. Such mixing of methods might provide completeness, adequacy and solidity to the research findings (Johnson, Onwuegbuzie & Turner 2007; Tashakkori & Creswell 2007). As postulated by pragmatists, individual researchers are "free" to choose the methods, techniques, and procedures of research that best meet their needs and purposes (Creswell 2014). The paradigm is likely to offer balanced views of quantitative and qualitative responses among the research participants in relation to the ICT adoption and use at schools and offer practical answers to the sub-research questions.

6.4 Mixed method design

Deriving from the pragmatic paradigm, this study employed a mixed methods approach that utilises both qualitative and quantitative. A mixed method design represents a strategy that combines elements of quantitative and qualitative methods, either in a chronological or in a concurrent manner, to best understand a topic. Qualitative and quantitative data are collected, analysed and the findings are in the end integrated. Conclusions are based on both qualitative and quantitative findings. Johnson and Onwuegbuzie (2007) argued that researchers combine elements of qualitative and quantitative approaches for the purpose of breadth and depth of understanding and corroboration.

Mixed method strategies afford special opportunities to use multiple sources of information from multiple approaches, to gain new insights into the social world (Axinn, Fricke & Thornton 1991; Kertzer & Fricke 1997). Varying the data collection methods can provide information from one approach that was not identified in an alternative approach and can ensure that a potential bias coming from one particular approach is not replicated in alternative approaches (Axinn, Fricke & Thornton 1991; Axinn & Pearce 2006; Babbie & Mouton 2010). Furthermore, the voices of respondents are indirectly heard in quantitative research but the method is weak in understanding the setting in which respondents talk. It is qualitative research which makes up for these flaws. Qualitative research also has weaknesses, such as the fact that generalising findings to a large population is difficult, because few participants are studied. This is countered by quantitative research, which permits the researcher to collect data from many respondents and findings can be generalised to a large population. Researchers can, consequently, partly overcome the weaknesses that flow from a single methodology by combining research methods (Babbie & Mouton 2010).

In this study, mixed method was employed. With regards to the mixed method, in-depth face-to-face interviews and focus group discussions were used to collect qualitative data, and a survey questionnaire was used to collect quantitative data.

Mixed method relies on data from multiple methods, thus allowing the researcher to improve the accuracy of her conclusions (Jick 1979; Ponce & Pagan-Maldonado 2015). Mixed method is aimed at deepening the understanding of issues under study. By using mixed methods, the researcher is able to use rich narratives to add meaning to numerical information in the study (Kuada 2012).

Although a mixed method design has several strengths, it also has certain weaknesses (Tashakkori & Teddlie 2010; Creswell & Plano-Clark 2011). The application of a mixed method design requires skills in conducting both quantitative and qualitative research and the researcher should be well familiar with both approaches. A mixed method design also requires a lot of time and various resources to collect and analyse quantitative and qualitative data. Almalki (2016) also argued that it can be difficult to integrate results, which requires expertise. Taking the pitfalls of a mixed method design into account, this research study, nevertheless, employed a mixed method design as it would allow me to get a deeper understanding of the topic under study through collecting both quantitative and qualitative data.

6.4.1 Personal in-depth interviews

Interviews are the most commonly used methods of data collection within the qualitative approach (Babbie & Mouton 2010). A qualitative interview is a two-way communication between the interviewer and the research participant in which the researcher has an overall plan of inquiry and directs the conversation (Babbie & Mouton 2010). A research interview is, thus, defined as a method of collecting data and acquiring knowledge from persons, which permits the interviewer to probe the interviewees further for more information and clarity (Neuman 2011).

Semi-structured interviews were conducted in this study. A semi-structured interview is defined as a data collection method where the researcher has a number of open-ended questions which cover the topic under study (Adejimi, Oyediran & Ogunsanmi 2010). Open-ended questions permit the researcher/interviewer and the interviewee to discuss issues raised in the interview further.

Advantages of interviewing are summarised by Seetaram, Gill and Dwyer (2012:370) as follows:

- is flexible to a variety of themes;
- allows the researcher to interpret body language which is usually impossible when using other methods of data collection;
- can provide the context for research using many methods;
- can provide detailed data and descriptive examples of individuals' experiences and,
- allows the researcher to take back the participants to issues discussed earlier thus ensuring its validity and accuracy.

In this study semi-structured in-depth face-to-face interviews were used to collect data from the school principals (see the interview guide in Addendum A). The three interviews were conducted at the beginning of February in 2018. At School A the school principal was interviewed on the 7th of February 2018. The school principal did not allow me to voice-record the interview electronically, so her responses were written down during the interview. At School B, the interview was conducted on the 9th of February 2018. At this school the principal allowed me to record the interview and also to transcribe the proceedings. At School C the interview was conducted on the 13th of February 2018. I was permitted to voice-record the interview and I also transcribed into writing the interview.

Questions that school principals were asked included how they felt about the adoption and use of ICTs at their schools, the availability of ICT support and training programmes for teachers, the challenges that they were facing in their adoption and use of ICTs, and the possible solutions to the identified challenges (see Addendum A). There were only four broad questions on the interview guide for this research study and follow-up questions were not prepared. Follow-up questions arose from the participants' responses to clarify issues and get more information from the participants.

It is argued that the success of the interview depends upon the interviewer's skill of asking clear questions (Phellas, Block & Seale 2011). Ambiguous questions might confuse the interviewee, who might be unable to respond to the question or answer out of topic. To ensure clarity on the nature of questions, the interview guide was developed, with the assistance of the supervisor of this study. Another weakness of a semi-structured interview is that the interviewer might unconsciously lead the interviewee to a desired response. In this research study, I avoided asking interviewees leading questions. The interviewees might also diverge from the issues under discussion. I always took the interviewees back to issues under discussion whenever they digressed. Details of the three principals who were interviewed are given in Table 6.1.

Table 6. 1: Details of participants

	Gender	**Number of years heading current school**
School A		
School Principal	Female	10 years
School B		
School Principal	Male	18 years
School C		
School Principal	Male	2 years

The principal of School A had been there for 10 years, whereas at School B, the principal had been heading the school for 18 years. At School C, the principal had been there for only 2 years. Two of the school principals had been in the position for a considerable time and could be regarded as more experienced, while one had been recently appointed.

I also faced some challenges when conducting the interviews with the school principals. At School C, my interview was cancelled on the day that it was scheduled. I was already at the school reception, waiting to conduct the interview. I had to adjust my data collection schedule and interviewed the principal the following day. Furthermore, an individual entered into the principal's office during the course of the interview. I had to pause the interview and the principal requested the individual to leave the office. This event disrupted the flow of the interview. I, however, reminded the principal about the issue that was under discussion before the disruption.

In the end I managed to conduct interviews with all the three school principals.

6.4.2 Focus group discussions

Qualitative data was also collected through focus group discussions with teachers. A focus group is defined as a small group of people with similar characteristics, selected from a broader population that is gathered to solicit group members' views, attitudes and experiences relating to a particular topic under study (Menter, Elliot, Holme, Lewin & Lowden 2011; Nyumba, Wilson, Derrick & Mukherjee 2018). Focus group discussions are a form of a group interview in which the researcher relies on the interaction within the group to solicit qualitative data from participants (Creswell 2014).

This study employed a less structured approach to the focus group discussions. A less structured approach to focus groups is commonly adopted in social science research (Morgan 2002). The participants are encouraged to talk to each other instead of answering the interviewer's questions. The interviewer stimulates a group discussion between participants and takes a peripheral role (Hohenthal, Owidi, Minoia & Pellikka 2015). Furthermore, a successful focus group discussion relies on "the development of a permissive, non-threatening environment within the group" where the participants feel comfortable to discuss their opinions and experiences without fear that they would be judged or ridiculed by others in the group (Hennink 2007: 6).

Focus group discussions offer the interviewer a means of obtaining an understanding of a wide range of views that participants have about a specific issue as well as how they interact and discuss the issue (Conradson 2005). Thus, the interviewer might be able to obtain an in-depth understanding of the several interpretations of a particular issue from the participants. To add on to that, focus group discussions allow the interviewer to ask for the reasons why particular views are held by the participants.

Focus groups can be used as a data collection method in their own right but can be used to complement other methods (Gibbs 2013). In this study, the focus group discussions and in-depth face-face interviews are qualitative data gathering techniques whose findings complemented the quantitative survey findings. In this research study, a semi-structured interview guide was developed to solicit data from the focus group participants (see the interview guide in Addendum B). The questions pertained, among others, to how teachers felt about the use of ICTs in their teaching, whether they received, and what kind, of ICT training, whether, and how, they integrated the ICTs in teaching and learning, what they believed could be done to enhance the use of ICTs, and the challenges that they were facing in the adoption and use of ICTs in the classroom.

In the focus group discussions, participants interacted with each other, rather than with the interviewer, such that the views of the participants could emerge (Menter et al 2011; Cohen, Manion & Morrison 2018). In this study, an environment was created which allowed the participants to freely interact among themselves. Thus, teachers' experiences on their adoption and use of ICTs in teaching and learning were revealed through the discussions.

Focus group interviews also have shortcomings. It is posited that a weakness of focus groups is that one participant may dominate, to the exclusion of others (Mathiyazhagan & Nandan 2010). I always asked other participants how they felt and/or what they thought about issues that were being discussed so that everyone participated in the discussions. It is also argued that focus group discussions depend on participants' dynamics and some individuals might feel uneasy with each other (Nyumba et al 2018). In such situations participants might not discuss their feelings and opinions freely. I conducted the focus group discussions in a relaxed, comfortable and enjoyable environment which allowed the participants to freely discuss issues among themselves.

Despite the mentioned weaknesses of focus group interviews, I decided that focus group interviews were amongst the best methods to collect data towards achieving the main aim of the study.

Selection of focus group participants

Participants for the two focus groups at each school were purposively selected with, the assistance of deputy heads at each of the three schools included in the study. Purposive sampling is also known as deliberate sampling (Kothari 2004; Etikan, Musa & Alkassim 2016). Each focus group had eight teachers. I requested the deputy heads that teachers who teach different subjects and grades be selected in order to get a deeper understanding of the teachers' experiences in ICTs use in teaching at various levels. It came to my attention that not every teacher had access to ICTs in teaching and learning at the three schools. I, thus, requested that the focus groups should also include teachers who were not using ICTs to teach, as I wanted to get a wide-ranging understanding of the adoption and use of ICTs at schools.

The details of the participants are tabulated below.

Table 6. 2: Details of teacher participants by gender, teaching experience and subject currently taught

School A Focus Group 1				
Participant	**Gender**	**Age**	**Subject currently taught**	**Teaching experience**
Teacher 1	Female	54	Social sciences	31
Teacher 2	Female	44	Home Language (SeSotho)	20
Teacher 3	Female	35	Mathematics	10
Teacher 4	Female	38	Business studies	12
Teacher 5	Male	28	Physical sciences	4
Teacher 6	Male	46	Geography	20
Teacher 7	Male	31	English First Additional Language	7
Teacher 8	Male	53	History	27
School A Focus Group 2				
Participant	**Gender**		**Subject currently taught**	**Teaching experience**
Teacher 1	Female	48	Home Language (Sesotho)	21
Teacher 2	Female	54	Tourism	20
Teacher 3	Female	42	Accounting	16
Teacher 4	Female	28	Mathematics	6
Teacher 5	Male	28	English First Additional Language	6
Teacher 6	Male	28	Physical science	4

Teacher 7	Male	49	History	22
Teacher 8	Male	39	Mathematics	10
School B Focus Group 1				
Participant	**Gender**	**Age**	**Subject currently taught**	**Teaching experience (years)**
Teacher 1	Female	55	Life science/Natural science	26
Teacher 2	Female	55	Home Language (IsiZulu)	35
Teacher 3	Female	26	English First Additional Language	3
Teacher 4	Female	26	Physical sciences	3
Teacher 5	Female	38	Geography	15
Teacher 6	Male	54	Mathematics	28
Teacher 7	Male	50	History/Life orientation	20
Teacher 8	Male	40	Business studies/Economics	17
School B Focus Group 2				
Participant	**Gender**		**Subject currently taught**	**Teaching experience**
Teacher 1	Female	40	Mathematical Literacy/Mathematics	5
Teacher 2	Female	40	English First Additional Language/Geography	9
Teacher 3	Male	34	Life sciences	7
Teacher 4	Male	44	Mathematics	18
Teacher 5	Male	51	Physical sciences	27

Teacher 6	Male	52	History	20
Teacher 7	Male	34	English First Additional Language	9
Teacher 8	Male	56	Geography	19
School C Focus Group 1				
Participant	**Gender**		**Subject currently taught**	**Teaching experience**
Teacher 1	Female	34	Consumer studies	9
Teacher 2	Female	47	English First Additional Language	17
Teacher 3	Female	26	Physical Sciences	4
Teacher 4	Female	46	Tourism	18
Teacher 5	Female	24	Life sciences	2
Teacher 6	Male	56	Economic and Management sciences	20
Teacher 7	Male	53	Geography	20
Teacher 8	Male	55	Business studies	29
School C Focus Group 2				
Participant	**Gender**		**Subject currently taught**	**Teaching experience**
Teacher 1	Female	28	Mathematical Literacy/Mathematics	4
Teacher 2	Female	36	Life sciences	9
Teacher 3	Female	47	English First Additional Language	15
Teacher 4	Female	38	Geography	12
Teacher 5	Female	29	Social sciences	5

Teacher 6	Male	34	Life Orientation	9
Teacher 7	Male	40	Home Language (IsiZulu)	14
Teacher 8	Male	36	Business studies	10

Procedures followed in conducting the focus groups

I telephonically communicated with the principal of School A a day before the discussions, to remind her of my request to conduct focus group discussions. I did the same with the principal of School B. I, however, went in person to School C. All six focus group discussions were conducted in the beginning of February 2018. Focus group discussions at School A were conducted on the 7th and the 8th of February 2018. At school B discussions were conducted on the 9th and 12th of February 2018, and at School C on the 13th and 14th of February 2018.

I introduced herself to the participants and explained the aim of my study. I also assured the participants that the discussions would remain confidential. Each participant signed an informed consent form. I also voice-recorded responses for the groups where the participants gave permission to do so.

I conducted the discussions on my own due to financial constraints. Paul, Williamson, Korp and Dalphin (2007) proposed the following procedures which I followed:

-I appropriately dressed to suit the school environment,

-I introduced myself to the research participants, explaining that is, I am a doctoral student at the University of South Africa.

-I prepared an interview guide, as well as a cover letter specifying the topic under investigation and the importance of the topic to the participants

-I briefly explained my study to the participants, to ensure that they understood the purpose of my study.

-I gave consent forms to participants to read and sign before the discussions commenced.

-I ensured participants’ confidentiality was protected.

-The time frame for the interview was included in the cover letter, that is, about 45 minutes.

-I thanked the participants after each interview and gave refreshments, as well as a small token of appreciation to the participants.

At School A the deputy head allowed me to use her office to conduct the two focus group discussions. The first focus group did not feel comfortable being voice-recorded. The second focus group discussion was electronically voice-recorded. Field notes were made after each group discussion.

At School B, the deputy head allowed me to use the staffroom to conduct my research and notified other staff members that the staffroom was occupied for an hour. On the second day at this school, the deputy head assigned me to a senior teacher who took me to his office where I conducted the discussions. Both discussions were voice recorded and thereafter transcribed.

At School C, again the deputy head allowed me to use the staffroom to conduct research with the first focus group. The deputy head also notified other teachers that the staffroom was occupied for about an hour. The second focus group at this school was conducted in the library which was not occupied by that time. The first focus group allowed me to voice-record their responses and I also transcribed the responses into writing. However, the second focus group did not allow me to use a voice recorder so I made field notes afterwards.

Challenges faced during the focus group discussions

A challenge that I faced when conducting focus group discussions at School A was that, though the deputy head had allowed me to use her office, I was, however, disrupted during the first interview, just after it had commenced. The deputy head walked into her office while talking so she was partly voice-recorded.

At School B, the second interview was conducted in a senior teacher’s office, which was close to classrooms. Students were on their lunch break at the time when the interview was conducted so there was a lot of noise outside the office. I requested the senior teacher to ask the students to move away from that office window and the students complied.

At School C, though the teachers had been informed that the staffroom would be occupied during the lunch hour for the interviews, some teachers walked in and started talking. This included the school principal who was aware that an interview had commenced in the staffroom. One of the focus group members had to request the teachers to leave and they did in the end, although they had resisted initially. Hence there were other voices that are heard at the background of the voice-recorded interview. The interview had to be paused after the interruptions and I reminded the teachers about the question that was under discussion before the interruptions.

Despite the mentioned challenges, I was able to collect data from the teachers that assisted me in getting deep insight into the issues related to the aims of my study.

Analysis of data from interviews

In this study qualitative data were analysed thematically to identify themes. Thematic analysis is a method for identifying, analysing, organising, describing, and reporting themes found within a data set (Braun & Clarke 2006). I analysed all the qualitative data written down and voice-recorded during the in-depth interviews and focus group discussions. I looked for themes and ideas that were central to answering the research questions. Thick narrative descriptions of the themes were presented. Most of the themes constituted the subheadings in Chapter 7, which is a presentation of the qualitative data.

I followed Braun and Clarke's (2006) proposed six phases on how to analyse data gathered from interviews.

Braun and Clarke (2006) proposed the following phases in conducting a thematic analysis of qualitative data:

Phase 1: Familiarising yourself with your data. This involves reading and rereading data. I familiarised myself with the breadth and depth of the data that I collected (field notes and electronically-recorded interviews). I read the field notes repeatedly, played and replayed the voice-recorded interviews, searching for meaning.

Phase 2: Generating initial codes. I generated initial codes from the data.

Phase 3: Searching for themes. I categorised the data into themes.

Phase 4: Reviewing themes. This phase involves reviewing themes, discarding themes with no supporting data and merging themes. I reviewed all the developed themes and reduced them into important ones.

Phase 5: Defining and naming themes. This phase involves naming themes so that each theme name identifies the "essence" of what each is all about. I defined and named all the themes. The main themes were generated from the sub-research questions for this study.

Phase 6: Producing the report. The themes found in data are listed and described. I presented a detailed analysis of each theme (see Chapter 7 for the results of the qualitative component of the study).

6.4.3 Trustworthiness of qualitative data

The trustworthiness of the qualitative component of this study was verified by applying the criteria that are considered by qualitative researchers, such as, Schwandt, Lincoln & Guba (2007). These are dependability, credibility, transferability and confirmability.

Credibility

Credibility is defined as the confidence that can be placed in the truth of the research findings (Macnee & McCabe 2008). In order to ensure credibility in this study, all field notes were kept and also the electronically-recorded interviews. Field notes and the recorded interviews were used to present and analyse data.

Transferability

Transferability is the degree to which the results of qualitative research can be transferred to other contexts with other participants (Bitsch 2005; Neuman 2006; Anney 2014). This research study elaborated and justified the criteria that was used to purposively select participants and thick descriptions of the phenomenon under study are made to ensure transferability of findings.

Dependability

Dependability is defined as “the stability of findings over time” (Bitsch 2005:86). It is whether the research findings would be consistent if the investigation were replicated with the same participants or similar context (May 2011). In this study, the dependability of findings was ensured by sufficiently explaining data collection and analysis methodologies, to help determine the replicability of findings.

Confirmability

Confirmability focuses on whether data and interpretations of the findings are not figments of the researcher’s imagination, but are solely derived from the participants (Tobin & Begley 2004). In this study confirmability was ensured by electronically recording interviews and writing down field notes. In this research study, research instruments, that is, the survey questionnaire and interview guides were used to promote confirmability.

*6.*4.4 The questionnaire survey

The quantitative component of this study entailed a questionnaire survey among teachers. A questionnaire is a data collection instrument consisting of a series of questions and other prompts, for the purpose of gathering data from the respondents (Mathiyazhagan & Nandan 2010). Respondents complete a printed questionnaire.

A questionnaire allows many questions to be asked and gives the researcher some flexibility in analysing the data collected (Babbie & Mouton 2010).

Furthermore, a questionnaire does not only allow a large quantity of data to be collected simultaneously over a short duration, but also allows a variety of information to be collected from participants (Thomas 2003; Fink 2015; Cohen, Manion & Morrison 2018). Questionnaires also allow the participants to take their time to read carefully and answer the questions.

Despite the stated advantages, a questionnaire also has disadvantages which are summarised by Finn and Jacobson (2008). These include possible misinterpretation of the questions by respondents, and this was partly rectified by piloting the questionnaire. The questionnaire was piloted at a school which is in the same local municipality as the three schools in this study. This school also had a computer laboratory and/or tablets, the internet, as well as smart boards. Another weakness of a questionnaire is that respondents might hastily answer the questions and may not even finish answering all the questions, especially if the questionnaire is too long (Adams & Cox 2008). In this study, a questionnaire which was not too long was designed, but it captured all the themes that are important for the investigation. Respondents were also requested to answer all the questions. The respondents were asked to return the questionnaires in two days, thus giving the respondents ample time to complete the questionnaire.

Sampling of the respondents

The sampling technique that was employed was a census survey. A census survey refers to an attempt to gather information about every member of the population (Babbie & Mouton 2010). This sampling technique was employed because this research study intended to include all the teachers at the three schools. The final realised sample consisted of 94 black teachers. The actual total number of teachers at the three selected schools was 150. However, only 94 of the respondents returned the questionnaires, translating to a 67 per cent response rate.

The nature of the questionnaire

A survey questionnaire which comprised a number of closed-ended questions and an open-ended question related to the aims of the study was used in this study (see the survey questionnaire in Addendum D). Paper-based, self-administered questionnaires were used to collect quantitative data from the respondents.

The questions were categorised into sections, namely: the teachers' demographic data, the availability of ICTs infrastructure at school, teachers' levels of ICT competencies, the integration of ICTs in teaching and learning, ICT training and support needs of teachers and challenges faced by teachers in the adoption and use of ICTs in the classroom, and the teachers' perceived impact of ICTs in teaching and learning. Nominal question formats were used to obtain data regarding demographic characteristics such as gender, ratio format for demographic characteristics such as age, as well as interval scales, for example, five-point Likert-type scales for items related to ICTs competency. There was only one open-ended question which required the teachers to suggest possible solutions to identified ICT adoption and use challenges that they were experiencing at schools. Some respondents did not answer the open-ended question. I, however, managed to solicit responses about the possible solutions to the ICTs challenges at schools in the focus group interviews. The complete questionnaire is included in Addendum D.

Analysis of questionnaire data

In this study, the Statistical Package for the Social Sciences (SPSS) was used to analyse the quantitative data.

I adhered to Neuman's (2013) procedures thus:

-I pre-coded questionnaire A, B and C for each school before data collection.

-Each respondent was given a number so that I would be able to keep track the responses of each respondent.

-Data collected from each respondent questionnaire was transferred into a data record format that computer software can read.

Descriptive statistics such as frequency scores were calculated with a programme. The potential dimensions of items employed to measure particular themes were investigated by means of principal factor analysis with varimax rotation. Scales were computed by adding the items with loadings of 0.4 or more on a particular factor. The internal consistencies of scales were investigated by calculating Cronbach alpha's and inter-item correlation. A Cronbach alpha of at least 0.7 or higher was required as measures of satisfactory internal consistency. One-way analyses of variance (ANOVAs) were employed to establish the significance of the difference between the three schools as well as the potential differences for various demographic characteristics - Post-hoc Scheffe tests were further calculated to explore differences among the means.

The Kaiser-Meyer-Olkin (KMO) test was used to measure the sampling adequacy of variables. Pearson correlations were used to investigate the strength of association between variables. Multiple linear regression was further conducted to investigate the potential predictors of the integration of ICTs in teaching and learning.

Piloting the questionnaire

A pilot study is defined as "a preliminary examination of a few informants who are similar to the targeted informants of the later survey" (Paul et al 2007:124). The purpose of conducting a pilot study is, thus, to detect the potential weaknesses in the research instrument (Neuman 2011). A pilot study was conducted at another secondary school, in the Emfuleni Local Municipality. One of the reasons for conducting a pilot study was to check if respondents understood the questions included in the questionnaire. A researcher can deduce new important data that should be collected and remove futile lines of inquiry by conducting a pilot study (Paul et al 2007).

In this study, a questionnaire was piloted to 33 teachers and the respondents were given sufficient time to respond to the items on the questionnaire. I realised that a question on how often teachers used computer applications in teaching was difficult for some teachers. Hence some of them did not respond to all the questions related to computer applications. I included examples of each application to clarify the questions.

Procedures in collecting quantitative data through survey questionnaires

I requested the school principals that all teachers should participate in the survey if they were willing to do so. I was permitted to distribute the questionnaires during lunch hour, to avoid interfering with teaching time. At School A, the deputy head assisted me to distribute the questionnaires. At School B, the deputy head assigned a teacher to assist me in distributing the questionnaires. At School C, I distributed the questionnaires to teachers on my own.

I introduced myself to teachers and explained the purpose of my study. I kindly requested the respondents to complete all the items. Some respondents managed to complete the questionnaires on the day that I distributed them and immediately returned them. However, most of them failed to do so and I collected some of the questionnaires on the date agreed upon.

It was my intention to have all teachers participate in this study, but some teachers refused. They mentioned that they were tired of teaching and had marking of learners' class activities so they would not get time to complete the questionnaire. Some said that they did not want to be disturbed. School A had a total number of 50 teachers who were all given questionnaires of whom, 33 returned the questionnaires, translating to a 66 per cent response rate. School B had a total of 40 teachers who were again all given the questionnaires, of whom 30 teachers returned the questionnaire. Thus, 75 per cent was the response rate at this school. School C had 60 teachers but 50 of them agreed to participate in this study. Of the 50 teachers that were given the questionnaires, 31 of them returned the questionnaires, translating to a 62 per cent response rate. Therefore, a total number of 94 respondents returned the questionnaires out of 140 from all the three schools, translating to a 67 per cent response rate.

There are procedures and techniques which were followed to collect data from respondents. In this study, followed Kuada's (2012:110) procedures were followed:

-The questionnaire was accompanied by a covering letter that introduced the respondents to the research, stressing objectives and encouraging participation. The letter also identified the research area and the institution that I am studying at (see Addendum C).

-I asked the respondents to return the questionnaires in two days.

-I stated, in the cover letter and also by word of mouth that the questionnaire would be returned to me at the respondent's workplace.

-I thanked each respondent who returned the questionnaire for participating in the study.

Challenges faced during quantitative data collection

One of the challenges that I faced when collecting quantitative data was that I distributed questionnaires to all of the teachers who had indicated that they were interested in participating in the study. However, not all of them returned the questionnaires, citing that they had forgotten them at home and would request me to come and collect the questionnaires on a particular day. I would go again to the schools, but still failed to get the questionnaires. Some teachers said that they had lost the questionnaires and were not willing to be given another questionnaire. However, some of them asked for other questionnaires and completed them in my presence.

I requested that the questionnaire be returned in two days at the respondents' workplace but some respondents failed to return the questionnaires on time. I, thus, spent more days going to all the schools to collect the questionnaires than I had scheduled.

Administering the questionnaire at School C was a challenge because I was told by the deputy head to go around the school distributing the questionnaires on my own. I was not familiar with the school premises. Teachers' offices were located in different classroom blocks and floors.

Despite the challenges, I managed to get a reasonable number of completed questionnaires. I administered 140 questionnaires to teachers and 94 returned the questionnaires, translating into a return rate of 67 per cent. Sivo, Saunders, Chang and Jiang (2006) argue that non-response error threatens the external validity and statistical validity of inferences made in research using questionnaires. Sivo et al (2006) further postulate that a response rate of 60 per cent, is good while 70 per cent is very good. A response rate of 67 per cent for teachers was obtained in this study, guaranteeing accurate and useful results.

Reliability of quantitative data

Reliability concerns the extent to which any measuring procedure employed repetitively to the same object, yields the same results (Babbie & Mouton 2010; Bryman & Bell 2011). In this study, the following steps were taken in order to ensure the reliability of the research findings:

-The reliability of the questionnaire was enhanced by piloting the questionnaire and by changing the wording of some questions to avoid misunderstanding.

-Reliability was also enhanced by the use of probability sampling.

Validity of quantitative data

Validity is defined as the extent to which a test measures what it is intended to measure (Kothari 2004; Cohen et al 2018). The questionnaire was used to measure what they were supposed to measure, ensuring construct validity. The supervisor of this study evaluated the questionnaire to enhance face and content validity.

6.5 Ethical considerations

An ethical issue is “concerned with whether the behaviour conforms to a code or a set of principles” (Bless et al 2013:28). Thus, research ethics are referred to as the principles that guide research, from the start to the end of the study (Bryman 2012). Data were collected from human subjects through in-depth interviews, focus groups and a survey questionnaire. Permission to conduct research was sought from the Gauteng Provincial Department of Education Head Office (see Addendum F).

6.5.1 Access

Access is defined as “the appropriate ethical and academic practices used to gain entry to a given community for the purposes of conducting formal research” (Jensen 2008:3). In this study I gained access to the Sedibeng West District secondary schools through the head office of the Gauteng Department of Education in South Africa. I was granted permission to conduct research in the district. I also asked for permission to do my research at particular schools, from the school principals.

Furthermore, I had to get formal research ethics clearance from her university (see Addendum G). In this study, a research ethics sheet was completed for the research ethics board at the University of South Africa. Also, a letter permitting me to conduct research is attached to my proposal. The permission letter was obtained from the Gauteng Department of Education head office, after scrutinising the research proposal. The Gauteng Department of Education allowed me to conduct my research in the province and I produced the letter to the school principals selected for this study.

6.5.2 Anonymity

Anonymity means that the identities and responses of research respondents and participants cannot be identified (Ogden 2008). In this study the privacy of schools was protected by the use of pseudonyms; the three schools are named

A, B and C. Research participants used numbers instead of their names in order to protect their privacy. Research participants can disclose sensitive information if their identity is protected. Personal information that the respondents revealed included their gender, age, ethnicity, educational qualifications and employment status.

6.5.3 Confidentiality

Related to anonymity is the issue of confidentiality. Confidentiality is paramount to human dignity. Ogden (2008) argues that data collected from the research participants should not be disclosed in a way that can reveal the identity of the participants. In this study, confidentiality was protected through the use of pseudonyms. Pseudonyms were used when findings for this study were presented and discussed. With confidentiality, research participants may be willing to share even sensitive information. Thus, confidentiality assists in enhancing both validity and quality of data (Ogden 2008).

6.5.4 No harm to participants and respondents

In this study, harm to the participants was avoided. I did not harm the research participants' feelings, privacy and confidentiality by strictly adhering to research ethics.

6.6 Conclusion

In an attempt to have a deeper understanding of the adoption and use of ICTs in teaching and learning at the secondary schools under study, this research study applied the research methodology as discussed in this chapter. The results of the two data sets, qualitative and quantitative, are presented separately in chapters seven and eight, respectively. The interpretation of both the qualitative and quantitative data is done in the last chapter.

CHAPTER 7

QUALITATIVE DATA PRESENTATION

7.1 Introduction

The previous chapter dealt with the research methodology used to explore the aim of this study. The use of ICTs in teaching and learning has gained attention all over the globe, with nations striving to connect schools to information networks in the information society, but the reality of the digital divide remains in existence (Mikre 2011; Oyedemi 2012; Chisa & Hoskins 2014). The results of the thematic analysis of data from the focus group discussions and the in-depth interviews are presented. The semi-structured interview guide and the focus group discussion guides probed how teachers felt about using ICTs, how they integrated the technologies in their teaching, what they thought could be done to enhance the use of ICTs in the classroom, the challenges faced when using the technologies and what could be done to counter ICT related challenges at their schools. The chapter thematically presents the findings that address the research objectives outlined in Chapter 1.

7.2 Thematic analysis of personal in-depth interviews

To answer the main question of the study, in-depth face-to-face semi-structured interviews were conducted with the three school principals.

7.2.1 Available ICTs employed at schools for teaching and learning purposes

To answer the first sub-research objective on identifying technologies available for teaching and learning, I visited the schools' ICT laboratories and I was also taken to classrooms that had mounted smart boards. ICTs that were available for teaching and learning at the time that this study was conducted were smart boards, laptops and overhead projectors. Tablets were not yet given to Grade Twelve learners by the Department of Education (DoE). The internet was available at the administration offices at all three schools. Only one smart board at School B was connected to the internet. The rest of the smart boards at the three schools were not connected to the internet. Some Grade Eleven teachers were given laptops by the DoE. A detailed description of available ICTs at each school was done in the previous chapter (see sections on school profiles).

The first sub-research question generated other sub-themes which included: inadequate ICT infrastructure for teaching and learning, limited internet access, theft and vandalism of ICT infrastructure at schools, and insufficient content uploaded on some ICTs such as smart boards, laptops and tablets. These are discussed in the sub-sequent sections of this chapter.

Inadequate ICT infrastructure for teaching and learning

The three school principals all stated that there was inadequate ICT infrastructure for teaching and learning at their schools. Limited ICT infrastructure prevented some teachers from adopting and using ICTs in teaching and learning.

A school principal at School A said:

> The school used to be on Gauteng online but is now disconnected. Tablets are only given to Grade Twelve learners. It is again these Grade Twelves whose classrooms have smart boards installed in them, so it's only Grade Eleven and twelve teachers who use the smart boards.

The other two school principals shared the same sentiments as the School A principal. They stated that ICT infrastructure was insufficient at their schools. The School A principal stated that some Grade Eleven teachers were given laptops by the DoE. However, some of the laptops were not functioning and were returned to the DoE. Inadequate ICT infrastructure, thus, hinders the use of ICTs in teaching and learning.

Limited internet access

The principal of School C said that all the computers in the Gauteng online laboratory were not functioning. The Gauteng online laboratory was switched off by the DoE in 2015. The principal further explained that the DoE wanted to refurbish the computer laboratory hence switched off the internet. That was not yet done at the time that this study was conducted.

Theft and vandalism of ICT infrastructure at schools

The school principals all concurred that theft and vandalism were very high in the communities where the schools were situated. According to the principal of School A, schools have security guards but they do not help much as they are simply tied up by thieves during robberies.

The three school principals all echoed the same observation that learners were also robbed of their tablets in the community. The principal of School B argued that since there was no Wi-Fi at school learners would go to hotspots at the nearby Evaton Mall, where they were robbed of the tablets. In some instances, robbers would forcefully take tablets from learners while on their way between homes and schools.

The school principal of School A said that the DoE rolled out computers in the Gauteng online laboratory twice, but all the computers were stolen.

Theft of ICT infrastructure, thus, prevented the adoption and use of ICTs in the classroom.

Power cuts

It also emerged from the interviews, that all the schools were affected by power cuts. The principal of School B said that the school did not have electricity most of the time during winter.

Late delivery of tablets to schools

By the time that this study was conducted, the DoE had not yet given tablets to learners at all the three schools. All the three school principals agreed that learners had not yet received tablets from the DoE.

7.2.2 Teacher readiness to use ICTs in teaching and learning

The school principals were presented with numerous questions soliciting their responses on their readiness to use ICTs in teaching and learning. This was done in order to answer the second sub-research question on investigating teacher readiness to use the identified technologies in the classroom.

Limited ICT skills among teachers

The principal of School A explained that teachers who recently graduated from colleges /universities had ICT skills and were using ICTs in teaching and learning, but the senior teachers were not trained in ICT skills at colleges/universities, so they had inadequate skills. Of the same sentiment was the school principal of School C, who argued that learners had more advanced ICT skills than teachers.

Inadequate ICT training

The school principals expressed concern regarding the duration of the training workshops that teachers underwent. The principal of School A said that teachers were inadequately trained on how to use ICTs in the classroom. The same principal further explained that continuous training was required for teachers to confidently use the ICTs in teaching and learning.

It also emerged from discussions, that classes rotated and that teachers did not teach the same grades every year. Some teachers who were never trained in using ICTs were teaching classes that had ICTs available for teaching and learning. A school principal at School C explained:

> Teachers were trained over the last two years. However, because of the rotation system in terms of allocating teachers every year, you might find that there are new teachers in Grade Eleven and Twelve who were not trained at that time when training was rolled out.

Fear of ICTs

The principal of School A explained that some teachers were afraid of using ICTs because they had limited digital skills, thus they avoided the technology. The principal also stated that with time, such teachers will have to use ICTs because "ICTs are here to stay therefore teachers need to improve skills". The principal further said that the fact that the teachers used mobile phones showed that they had some ICT skills.

7.2.3 ICT support programmes available for teachers

Establishing factors that influence the integration of ICTs in teaching and learning was one of the objectives of this study. This research study established that ICT support programmes, which included the availability of an ICT technician at schools and a continuous ICT training for teachers, were some of the support that teachers required.

The school principals of the three schools concurred that the DoE deployed an ICT specialist at their schools to assist teachers when using ICTs in teaching and learning. The ICT specialist also assisted teachers who were not trained on how to use the smart boards.

The principal of School A stated that an ICT technician was school-based but then his contract expired. The technician was outsourced from private contractors. He would come to fix smart boards when called to do so. However, the technician took a long to come to schools. Thus, some ICTs, such as smart boards, were not working at the time that this study was conducted at the three schools.

7.2.4 Possible solutions to challenges faced by teachers in their adoption and use of ICTs in teaching and learning

The challenges that were identified in this study might hinder the adoption and use of ICTs at schools. Thus, in order to answer the sub-research question on possible solutions to challenges faced by teachers in their adoption and use of ICTs in teaching, I asked research participants to offer suggestions. Some participants thus proposed possible solutions to the ICTs barriers to teaching and learning.

The school principal of School C suggested that the DoE should give learners tablets on time. Teachers might not resort to traditional methods of teaching if learners have access to tablets. The same school principal proposed that the entire school should have access to the internet.

ICT training for teachers was insufficient. The three principals all suggested that teachers should be continuously trained at schools.

7.2.5 The school principals' opinions with regards to the impact of ICTs in teaching and learning

This study gathered data on the impact of ICTs in teaching and learning from the participants.

The principal of School B argued that adoption and use of ICTs in teaching and learning at the school resulted in the improvement of the matriculation results (final year of secondary school and qualification received on graduating from secondary school). The results improved from 79% in 2016 to 83.7% in 2017. He argued: "Information is accessible to teachers and learners. The information is here at our finger tips. E-books are installed on smart boards." That was, however, disputed by the principal of School A, who argued that the use of ICTs in teaching and learning did not really have an impact on the performance of learners.

In order to get an in-depth understanding on the main aim of the study, data was also solicited from teachers through focus group discussions.

7.3 Thematic analysis of focus group discussions

In order to get a deep understanding of the phenomenon under study and augment the school principals' responses, focus group discussions were conducted with teachers. Focus groups from the three schools are coded as follows: School A (A1 and A2), School B (B1 and B2) and School C (C1 and C2).

7.3.1 Inadequate ICT infrastructure for teaching and learning

Teachers were also asked to identify technologies available for teaching and learning at schools and that answered the first sub-research question in this study. The six teacher focus group interviewees all corroborated the viewpoints of the three school principals regarding the inadequacy of ICTs at schools.

Inadequacy of ICT infrastructure at schools was further revealed by teachers in the second focus group at School C. It emerged, from discussions with C2 teachers that some Grade Eleven and Twelve classes did not have smart boards because the learners had increased in number, meaning more classes than before. Thus, out of the seven Grade Eleven classes at the school, only four classes had smart boards. It was further stated that four Grade Twelve classes had smart boards and two classes did not have at the particular school. The two classes did not have smart boards because one smart board was no longer working and the other one was not yet installed. By the time that I conducted the second focus group discussion with teachers at School A, all smart boards had stopped working. The teachers said that they had already resorted back to traditional methods of teaching. Some teachers even explained that it was difficult to teach because some classes with malfunctioning smart boards had neither a chalkboard nor a whiteboard.

The scenarios at the three schools explain why a teacher in B2 shared the sentiment that:

> There was no need to be trained yet we were not given enough ICT infrastructure to use when teaching. We need adequate ICTs that we continue practising.

Limited access to educational software

It emerged, from the first focus group at School C, that:

> Not all the information that is on the smart boards is on my laptop. Some things are missing. I don’t have everything. But I understand that late last year, 2017, the laptops were requested to be checked if they were

> functioning properly and whether they have the information that's required to be on the teacher's laptop, but then they were given back.

Echoing the same sentiments were teachers at C2, who revealed that some teachers were given laptops with wrong textbooks and that was yet to be rectified.

Another teacher at B2 further explained that:

> When tablets were given to Grade Twelve learners, they had nothing on them. Teachers send past examination papers via Bluetooth to learners. Learners also download the past examination papers on their own. E-books were not installed on the tablets.

The Home Language teachers, for instance an IsiZulu teacher, furthermore lamented that there were no teaching materials on smart boards, tablets and laptops for Sesotho and IsiZulu languages. These teachers were, thus, not teaching using any available ICTs at their schools.

It also emerged, from the discussions with B1 and C1 teachers, that the laptops that some teachers were given by the DoE had information which was not related to what was installed on the smart boards. This made it difficult, if not impossible, for the teachers to teach using the laptops.

The smart boards, tablets and laptops only had one source (an e-book) of information per subject. That limited the teachers and learners to that particular e-book. A Grade Eleven English First Additional Language teacher also said that the e-book that was loaded on the smart board was not the one that was being used at the school.

Furthermore, all six focus groups agreed that there were very few e-books uploaded on smart boards for teachers to use in teaching. The very limited internet connection at the three schools could also mean that teachers could not search and download more e-books and other teaching and learning material available on the internet.

Limited internet access

Teachers concurred with the school principals' observation that there was limited internet access at schools. It emerged, from the interviews, that internet access was only available at the schools' administration blocks and also on a few smart boards. Some teachers highlighted that they used their own money to buy data if they wanted to conduct research for class notes on the internet.

All three schools once had functional access to the Gauteng online ICT laboratories, but a teacher at School C said that "Gauteng online is now Gauteng offline".

Furthermore, a teacher at School B had this to share:

> Tablets are useless in class. There is no Wi-Fi for them to get into the internet so we can't use them for education purpose when they are in class.

To further reveal the impact of limited and/or no internet access at all, a teacher at School A had this to share:

> The other challenge is that some teachers are trained but don't implement the acquired skills. Some of the activities that they are trained on use Wi-Fi. The teachers cannot use such programmes because some learners' tablets are not connected to the internet.

Limited access to the internet, thus, hindered some teachers from using ICTs in the classroom.

Conditions of some of the available ICT infrastructure

It emerged from the discussions with teachers, that the availability of smart boards in some classrooms did not necessarily mean they were in good working condition. A frustrated teacher in C1 had this to say:

> Sometimes they [referring to smart boards] just freeze. Today I was supposed to use it for my class and I actually prepared over the weekend a very interesting lesson. When I got there it just froze, it just turned on but

> nothing was on. It was just quiet. It couldn't talk to me and I wanted to communicate with it.

Another frustrated teacher in C1 said:

> It's a waste of time especially for people doing Science and Maths, having to go through a smart board, sometimes it's not even working. So it's a waste of time you are in class you want to get the smart board to work, half of the period is finished. By the time that you get it to work your period is over. So for me it's a waste of time.

Furthermore, the B2 focus group also revealed that learners' tablets were of poor quality. The tablets easily broke and learners would spend a term or even the whole year without the tablets. The first focus group at School C echoed the principal of School A, saying that some of the laptops that some Grade Eleven teachers were given by the DoE were either not functioning properly or not functioning at all. Thus, teachers and learners were using textbooks.

Theft and vandalism of ICT infrastructure at schools

Teachers echoed the viewpoints of principals regarding theft and vandalism of ICT infrastructure at schools.

I found out that all smart boards at schools were once connected to the internet. However, due to the theft of routers, they were no longer connected to the internet. For instance, teachers in B1 articulated that only one smart board out of ten was connected to the internet. The rest were not because the routers were stolen. Furthermore, at School C I found out that the antenna was also stolen, so smart boards could not be connected to the internet. Teachers in A2 revealed that electricity cables were stolen in some classrooms, so the smart boards could not be switched on. Thus, theft hindered the use of ICTs in teaching and learning.

The group of teachers in B1 further explained that the ICT laboratory at their school was broken into around October 2016 and all the computers were stolen. The school also had an MTN ICT laboratory, but the computers were also stolen.

It also emerged, from the discussions, that the tablets given to learners did not have trackers, hence some parents could take the tablets to money launderers. A teacher at School C revealed that:

> In terms of security we were told that they have a tracker but they actually don't. Some laptops [referring to tablets] were found at *kwamatshonisa* [money launderers]. The parents took them there and nobody tracked them down. It had no track number. It's only parents telling the department [referring DoE officials] that we took it there. The reason why the learner doesn't have it, the reason why my child does not have it is because we took it there.

Thus, theft of ICT infrastructure prevented the adoption and use of ICTs in the classroom.

Late delivery of tablets to schools

Teachers in A2 had similar view points with principals regarding the delivery of tablets to school. The teachers stated that Grade Twelve learners would be given tablets by the DoE around March. Hence learners would not have access to e-books that are installed on the tablets. This makes teaching and learning difficult. By the time that this study was conducted, Grade Twelve learners at all the three schools had not yet been given tablets by the DoE.

7.3.2 Teacher readiness to use ICTs in teaching and learning

In order to answer the second sub-research question, this research study solicited for teachers' responses on their readiness to use identified ICTs in teaching and learning.

Limited ICT skills among teachers

Teachers agreed with the principals' views regarding limited ICT skills that the teachers possessed. It emerged, from discussions that teachers were taken through some ICT skills training. However, they had inadequate digital skills as explained by a teacher in C2 group:

> To me it’s a little bit of a challenge because I’m not used to it [referring to a smart board]. There are a lot of things that I do not understand about it but for the learner it is very interesting. What is so funny to them is that as a teacher I don’t know how to use it. They will be laughing about it, just to know that there are things that ma’am don’t know, so they thought that ma’am knows everything. I always ask them to help me every time I am in class and I am using it, so they will be in control of it. I will just do some activities but most of the time they are the ones doing the activities.

Furthermore, a teacher in B2 elaborated:

> Some teachers rely on learners when using the smart boards because they have limited ICT skills. If learners do not want the lesson to be conducted, they play around with the smart board and the teacher fails to conduct the lesson. They sometimes do not show the teacher the programme that he or she might want to use when teaching and will only do so when the lesson is almost over.

Teachers in C2 also revealed that some of the teachers were only trained on the basic ICT skills so they did not possess advanced skills to teach beyond using the e-books installed on the smart boards. Thus, the second focus group at School C and the first focus group at School B teachers concurred that if learners were to write on tablets, the teachers would not be able to mark soft copy class activities because they were not trained to do that.

Furthermore, teachers in C1 and in B2 agreed that it would be better if they were trained for one year and not short term as it is often the case. One of the participant said:

> The training is short. We went for training in Nelspruit for three days. It is not sufficient particularly for BBTs [Born Before Technology]. It is better for the young ones.

Concurring with teachers in C1 and B2 was a teacher in A1 who had this to share:

> We went for training but it was not sufficient. We were only taught how to open and close the gadget [referring to the smart board]. We don’t know how to manipulate it [smart board].

The inadequacy of the ICT training courses was further revealed by teachers in B1. The group of teachers argued that more training was required to combat limited ICT skills among teachers. The teachers said that they should be gradually trained from simple to complex skills. Being trained a lot of skills within a limited period of time was a challenge because the teachers ended up not understanding anything. The training period was short and the ICT facilitators had pressure to finish up the course. Thus, the ICT facilitators ended up doing tasks that should have been done by teachers. Teachers were trained in 2016 but training did not continue in 2017, so they resorted back to textbooks.

Another participant from the first focus group at School A had this to share:

> Teachers are not given enough time to learn it [referring to the smart board], but expected to fumble in front of learners. It is frustrating and exposes you to the learners. We went for training but it was not sufficient. We were only taught how to open and close the gadget [referring to the smart board]. I don't know how to manipulate the gadget.

It came out of the first focus group at School C that some teachers were trained on how to use ICTs in teaching and learning but others were not. It was only Further Education and Training (FET) teachers (grades ten to twelve teachers) who were trained on how to use ICTs in the classroom. The teachers highlighted that training was "selective".

Furthermore, teachers were all trained once, regardless of the different levels of ICT skills that they already possessed. A teacher at A2 stated that:

> Teachers do not have the same level of understanding and grasping of concepts so the training was too short for some of us. We were all trained once though our levels of ICTs skills differ. It is difficult for some of us to grasp ICT skills especially those who are not acquainted with technology.

Teachers at School B concurred with those at School A, that teachers' levels of ICT skills differed. A B2 teacher said that being an English First Additional Language teacher, she rarely used the smart board when teaching. She gave an example of the teaching of literature and said that she preferred her learners to use hard copies and highlighting important information in the literature textbooks. She also said that she did not want her learners to write on the tablets because they automatically changed the spelling to American spelling. Learners' spellings were deemed bad and it affected them when writing English Paper three, which comprises essays, letters, dialogue and others. Another English First Additional language teacher in the second group (B2), however, said that she used the smart board to show videos and play audio recordings when teaching the subject.

Limited time to prepare lessons

This study solicited data through questions which required teachers' responses on whether they were using the ICT skills that they acquired at training workshops. A participant in C1 revealed that:

> Not all of them. Sometimes it takes a lot of time, a lot of preparation time that we do not have. You know when you have your textbook with you and you have your teacher's guide, you can do things very quickly but with the smart boards you need to prepare a PowerPoint presentation. It takes a lot of time. We need to mark. We need to rest.

ICTs are disruptive

Some teachers in C2 and A1corroborated the principal of School A, that the rolling out of tablets at their schools in August 2016 disrupted teaching and learning. They explained that learners focused on entertaining themselves, taking photographs, playing music and watching movies and were frequently not attending classes.

Furthermore, the group of teachers in A1 stated that the pass rate dropped after learners were given tablets because learners did not concentrate on educational uses of tablets but on entertainment. One teacher explained that that could be because it was for the first time that most learners were seeing and using the tablets, hence the over-excitement.

A teacher in C1 had this to say:

> Sometimes the learners don't listen to the teachers, they will be busy doing what they like on the tablet whilst the teacher is teaching.

Concurring with the teacher in C1 was another teacher in the same C1, who stated that:

> Sometimes the learners take pictures of us. You might find your picture on Facebook, so it's uncomfortable. I am a victim of such, like I was doing something in class and this learner starts putting out his tablets like that and is looking at me and somehow I felt intimidated and it distracted me. I was in my floor [referring to the time that the teacher will be conducting her lesson] and there is a learner recording me so it's uncomfortable. They take pictures of us and then they make fun of us on Facebook.

The misuse of tablets by some learners during teaching and learning does not only disrupt the teacher but also the learners. Teaching and learning might become ineffective if learners do not use tablets for educational purposes in class.

Teachers' attitudes towards ICTs use in teaching and learning

This research study gathered that for some teachers, it is not the limited ICT training course that hindered them from using ICTs in the classroom, but attitude towards the ICTs. This was brought to light by a teacher in B2, who explained that:

> It [referring to ICTs] came when I was 25 years in the profession. Generally, my mind, my computer, the brain is shut towards learning of new skills. They say it's an attitude but basically you know we are people who were born before this technology came. So it is maybe more preferable that if taken as a transition, the youngsters from the universities, you know, put in those classes with technology and then us you know we do the chalking in the lower grades where there are no smart boards.

A teacher at School B revealed that he initially did not want to use ICTs due to his limited digital skills and had this to say:

> I for example to be specific. I was hesitant, unwilling to use it [referring to a smart board] but because the learners themselves are experienced. They have got the techniques of using the smart board, you just let them be in front. Make them operate it for you". The teacher will just explain the concept to the learners.

Lack of support from the Department of Education

It was established that some DoE officials did not support teachers in their use of ICTs in teaching and learning. The officials were not interested in the "paperless" classroom, as revealed by one of the teachers in C1 who argued that:

> They [referring to learners] don't use them [referring to tablets] for writing. You can't give them homework or anything. Once the district comes for monitoring, they count the number of classwork inside the book and not anything related to technology.

Sharing the same view was a teacher in C1 who had this to say:

> When facilitators come here, they are looking for classwork books, they do not look for laptops and the tablet.

7.3.3 Purposes and how teachers use ICTs in teaching and learning

This research study solicited for data from teachers on purposes and how they used ICTs in teaching. That answered the sub-research question on factors that influence the integration of ICTs in teaching and learning. The teachers' use of ICTs in the classroom revealed that they had simple ICT skills.

It emerged, from teachers in C1, that teachers accessed e-books, past examination papers, teachers' study guides, video clips and memorandums installed on smart boards. They used the material for teaching and learning. For instance, teachers in A1 and C2 concurred that learners had different learning styles, the visual, the auditory and the sensual. The teachers said that they uploaded videos and pictures on the smart board to cater for all learners' learning styles.

A Life Sciences teacher in C2 said that she used PowerPoint slides to present her lessons. That minimised writing on the chalkboard, hence it saved her time. She further explained that she was able to explain abstract concepts and learners could see pictures on the smart boards when teaching Life Sciences. A teacher in B1, another Life Science teacher, concurred with a teacher in C2 and gave an example of teaching pregnancy. She said that learners were able to see how a baby is formed and how it develops in the womb.

An English First Additional Language teacher at School C said that she tested her learners' listening skills by playing an audio recording on her laptop. She further explained that her teaching was no longer traditional whereby it is only the teacher physically delivering the lesson.

7.3.4 ICT support programmes available for teachers

To further establish factors that influence the integration of ICTs in teaching and learning (sub-research objective three), teachers were asked ICT support programmes available to them. Teachers had the same viewpoints with the principals regarding ICT support programmes. There was an ICT school-based technician for three months and teachers would get more training twice a week. Teachers said that it was helpful to them. The participants also explained that they did not only improve their ICT skills but they also implemented the skills acquired. However, some of the participants argued that the support programme was conducted after working hours when they would be very tired.

Teachers in A1 also revealed that it was the DoE would send the technician to the school. The teachers explained that if they experienced hardware challenges when using the smart board, they would phone a call centre and would be given a reference number. The technician would come after a long time or never come at all.

7.3.5 Possible solutions to challenges faced by teachers in their adoption and use of ICTs in teaching and learning

The fourth sub-research objective of this research study was to proffer possible solutions to the challenges faced by teachers in their adoption of ICTs in teaching and learning. Teachers echoed the principals' viewpoints regarding possible solutions to challenges that they faced in their adoption and use of ICTs in the classroom.

A participant in B2 had this to propose:

> ICTs should be rolled out to all grades rather than to Grade Twelve learners only. The learner is faced with two things. He is learning a subject and he is also learning how to use a tablet. If tablets were introduced at Grade Eight, by the time they get to Grade Twelve, they are no longer interested in other funny things that are happening in the tablets. They concentrate on the subject.

Some participants reiterated one principal's view that the DoE officials should give learners tablets on time so that teachers do not resort to traditional methods of teaching.

Furthermore, teacher participants concurred that equipping teachers with ICT skills should be done continuously over a period of a year. The teachers also recommended that internet connection should be made available throughout the school premises.

Teachers also proposed that there should be tight security at the schools to prevent theft of ICTs. They also suggested that the DoE office should provide schools with a technician to repair broken ICTs.

7.3.6 The teachers' opinions with regard to the impact of ICTs in teaching and learning

Teachers shared the principals' mixed viewpoints regarding the impact of ICTs in teaching and learning. Some teachers believed that ICTs yielded positive results with regard to teaching and learning. Others felt, in contrast, that the technologies had little or/ no impact at all in the classroom.

Teachers in A2 argued that the use of ICTs has made it possible to reach learners beyond the classroom. The teachers argued that learners were connected to one another on chat groups on the tablets.

Individual teachers said that the pass rate per subject differed after the adoption and use of tablets at the school. For instance, a Geography teacher at School A said that the matriculation pass rate for his particular subject improved. This, however, contradicted with a Physical Sciences teacher in the same A1, who stated that the pass rate of his subject dropped after tablets were given to learners.

7.4 Conclusion

This chapter presented qualitative research findings. Both intrinsic and extrinsic factors that either hinder or enhance the adoption and use of ICTs among teachers in teaching emanated from the discussions with the research participants. The next chapter is a presentation of quantitative findings that this research study got from the respondents.

CHAPTER 8

QUANTITATIVE DATA PRESENTATION

8.1 Introduction

A mixed method design was employed, and the previous chapter was a presentation of the qualitative research findings. This chapter gives a presentation of the quantitative component of the study, namely, the results of the survey questionnaire administered to respondents at the three schools. The survey questionnaire aimed at soliciting data regarding teachers' access to, and use of, ICTs both at home and at school. Issues of ICT training and support needs of teachers, the impact of ICTs in teaching and learning, and challenges in the adoption and use of technologies were also addressed in the questionnaire.

8.2 Demographic characteristics of respondents

The distribution of the sample according to demographic characteristics are as follows.

Table 8.1: Demographic characteristics of respondents at the three schools.

	School A		**School B**		**School C**		**Total Sample**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Gender								
Male	10	30.30	11	36.67	13	41.94	34	36.17
Female	23	69.70	19	63.33	18	58.06	60	63.83
Total	**33**	**100.00**	**30**	**100.00**	**31**	**100.00**	**94**	**100.00**
Age (years)								
24-35	14	42.40	11	33.30	9	27.30	34	36.20
36-45	10	30.30	6	18.20	4	12.10	20	21.30
46-55	8	24.20	12	36.40	17	51.50	37	39.40

56-65	1	3.00	1	3.00	1	3.00	3	3.20
Total	**33**	**100.00**	**30**	**100.00**	**31**	**100.00**	**94**	**100.00**
Highest academic qualification								
Post matric: Certificate/ Diploma	3	9.06	5	16.67	3	9.68	11	11.70
Bachelor's degree	16	48.48	18	60.00	27	87.10	61	64.98
Honours degree	13	39.39	6	20.00	1	3.23	20	21.28
Master's degree	1	3.03	0	00.00	0	00.00	1	1.06
Other (Advanced certificate in education)	0	00.00	1	3.33	0	00.00	1	1.06
Total	**33**	**100.00**	**30**	**100.00**	**31**	**100.00**	**94**	**100.00**
Teaching experience (years)								
1-10	13	39.40	9	27.30	9	27.30	31	32.98
11-20	10	30.30	12	36.40	6	19.35	28	29.78
21-30	9	27.30	8	24.20	13	39.40	30	31.91
Over 30	1	3.00	1	3.00	3	9.10	5	5.32
Total	**33**	**100.00**	**30**	**100.00**	**31**	**100.00**	**94**	**100.00**
Rank/Position held								
Teacher	20	60.61	16	53.33	22	70.97	58	61.70
Senior teacher	6	18.18	8	26.67	5	16.13	19	20.21
Head of department	5	15.15	4	13.33	2	6.45	11	11.70
Deputy principal	2	6.06	2	6.67	2	6.45	6	6.38
Total	**33**	**100**	**30**	**100**	**31**	**100**	**94**	**100.00**
Employment status								
Permanent	33	100.00	30	100.00	30	96.77	93	98.94
Temporary	00	00.00	00	00.00	1	3.23	1	1.06
Total	**33**	**100**	**30**	**100**	**31**	**100**	**94**	**100.00**

From Table 8.1, it can be deduced that 36.17 per cent (N=34) of the respondents were male and 63.83 per cent (N=60) were female. There were, thus, more female than male respondents. It can be deduced, from the same table, that the majority of the youngest respondents who were in the 24 to 35 years age category were at School A (42.40 per cent; N=14), followed by School B (33.30 per cent; N=11) and then School C, (27.30 per cent; N=9). It was again at School A where most respondents (30.30 per cent; N=10) were in the 36 to-45 years age category. School B followed with 18.20 per cent (N=6) respondents and School C, 12.10 per cent (N=4) respondents in the same years age category. Most of the respondents who were in the 46 to 55 years age category were at School C, (51.50 per cent; N=17), followed by School B, (36.40 per cent; N=12), and then School A, (24.20 per cent; N=8). All the three schools had the same percentage of respondents within the 56 to 65 years age range, that is, 3.00 per cent (1 respondent). The age distribution of all respondents ranged from a minimum of 24 years to a maximum of 56 years. The mean age for School A was 39.15 years, for School B, 40.23 years and for School C, 43.32 years.

Furthermore, data in Table 8.1 indicates that all respondents had a post matric qualification. The majority of the respondents were holders of a bachelor's degree. These were 64.89 per cent (N=61) of the total number of respondents. School C had 87.10 per cent (N=27), School B, 60.00 per cent (N=18) and School A, 48.48 per cent (N=16) bachelor's degree holders. Therefore, School C had the most respondents with a bachelor's degree. There were 21.28 per cent (N=20) who had an honours degree. School A had 39.39 per cent (N=13) such respondents, School B, 20.00 per cent (N=6) and School C, 3.23 per cent (N=1) honours qualified respondents. School A had the most respondents with an honours degree. It was also at School A where 1.06 per cent (N=1) respondents had a master's degree. Schools B and C did not have master's qualified respondents. The total percentage of respondents who had a post-matric certificate or diploma was 11.70 per cent (N=11). School B had 16.67 per cent (N=5), School C, 9.68 per cent (N=3) and School A, 9.06 per cent (N=3) such respondents. School B had the most respondents with a post-matric certificate or diploma. A respondent at School B had an Advanced Certificate in Education, 1.06 per cent (N=1).

Teachers with the least number of years teaching had been in the profession for two years. The longest teaching experience was 35 years. The average teaching experience for all teachers was 15.99 years. There is a fair distribution of both new as well as the more experienced teachers. However, School A had the most novice teachers, 39.40 per cent (N=13) while School C had the largest percentage of more experienced teachers (39.40 per cent; N=13). It can further be deduced, from Table 8.1, that most teachers at School A, 39.40 per cent (N=13) had been teaching for 1 to 10 years. School B had 27.30 per cent (N=9) teachers who had been in the teaching profession for 1 to 10 years, School C had 27.30 per cent (N=9) such teachers. At School B, the majority of the teachers, 36.40 per cent (N=12), had been in the teaching profession for 11 to 20 years. School A had 30.30 per cent (N=10) and School C, 19.35 per cent (N=6) of teachers in the category 11 to 20 years. Lastly most of the teachers at School C - 39.40 per cent (N=13) - had been teaching for 21 to 30 years. School A had 27.30 per cent (N=9) and School B, 24.20 per cent (N=8) of teachers in the same category.

Data in Table 8.1 further illustrates teachers' positions of responsibility in their schools. The majority of the teachers were appointed on post level 1, that is, 61.70 per cent (N=58). School C had the largest percentage of teachers who were post level 1, that is, 70.97 per cent (N=22). School A had 60.61 per cent (N=20) such teachers and lastly, School B had 53.33 per cent (N=16) post level 1 teachers. Nineteen of the respondents were senior teachers, representing 20.21 per cent (N=19) of the total number of teachers. School B had 26.67 per cent (N=8), School A, 18.18 per cent (N=6) and School C, 16.13 per cent (N=5) teachers at senior level. The total percentage of heads of departments in the sample was 11.70 per cent (N=11). For School A, 15.15 per cent (N=5), School B, 13.13 per cent (N=4) and School C, 6.45 per cent (N=2) heads of departments participated in the study. The least number of heads of departments participated in the survey for School C. The total percentage of deputy school principals represented in the sample was 6.38 per cent (N= 6). School B had 6.66 per cent (N=2), School C, 6.45 per cent (N=2) and School A, 6.06 per cent (N=2) deputy school principals.

Only one respondent at School C, representing 3.23 per cent of that school and 1.06 per cent of the total sample, was a temporary employee. The rest of the respondents at the three schools were all permanently employed.

8.2.1 Teachers' subject specialisation at college/university

Table 8. 2: Frequency distribution of teachers' specialisation and teaching areas

		School A		School B		School C		Total specialisation areas	Total subject currently teaching
		University /college specialising area	**Subject currently teaching**	**University /college specialising area**	**Subject currently teaching**	**University/college specialising area**	**Subject currently teaching**		
Languages	**N**	17	15	15	13	25	20	57	48
	%	51.52	45.45	50.00	43.33	80.65	64.52	182.17	153.30
Natural Sciences	**N**	17	15	11	10	9	10	37	35
	%	51.52	45.45	36.67	33.33	29.03	33.33	117.22	112.11
Humanities	**N**	12	5	10	9	12	3	34	17

(such as Geography and History)	**%**	36.36	15.15	33.33	30.00	38.71	9.68	108.40	54.83
Technical subjects	**N**	6	00	2	00	2	1	10	1
	%	18.18	00.00	6.67	00.00	6.45	3.23	31.30	3.23
Commercial subjects	**N**	1	00	9	5	2	2	12	7
	%	3.03	00.00	30.00	16.67	6.45	6.45	39.48	23.12
Sports	**N**	00	00	00	00	00	00	00	00
	%	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
Total	**N**	**53**	**35**	**47**	**37**	**50**	**36**	**150**	**108**
	%	**160.61**	**106.00**	**156.67**	**123.33**	**161.29**	**117.21**	**478.57**	**346.54**

Some teachers specialised in more than one subject area hence, the total number of respondents is more than 94 (the total number of respondents). Furthermore, some were teaching more than one subject, thus, the frequency of subjects is again above 100 per cent.

It can be deduced that the majority of the teachers were currently teaching the subjects that they specialised in at college and/or at university. The majority of the teachers specialised in languages, such as English First Additional Language, SeSotho and IsiZulu, that is, 60.64 per cent (N=57) and 51.06 per cent (N=48) of them were teaching languages. School A had 51.52 per cent (N=17) language teachers, and 45.45 per cent (N=15) were teaching languages. School B had 50.00 per cent (N=15) language trained teachers, 43.33 per cent (N=13) were teaching language subjects. School C had 80.65 per cent (N=25) language teachers, and 64.52 per cent (N=20) of them were teaching languages. School C, thus, had the largest percentage of language teachers, followed by School B, and lastly School A.

Teachers who majored in Natural Sciences such as Physical Sciences and Life Sciences were 39.36 per cent (N=37). The majority of them were at School A, followed by School B, and lastly at School C. School A had 51.52 per cent (N=17) Natural Sciences trained teachers, and 45.45 per cent (N=15) teachers who were teaching Natural Sciences. School B had 50.00 per cent (N=15) Natural Sciences teachers, and 43.33 per cent (N=13) of them were teaching Natural Sciences. School C had 80.65 per cent (N=25) qualified Natural Sciences respondents, and 64.52 per cent (N=20) were teaching Natural Sciences. All in all, Natural Sciences teachers who were teaching science subjects were 38.23 per cent (N= 35).

Teachers who specialised in the Humanities such as Geography and History were 36.17 per cent (N=34) and 18.09 per cent (N=17) were teaching the subject specialised in. School C had the most teachers who specialised in humanities (38.71 per cent; N=12), but had the fewest teachers (9.68 per cent; N=3) who were teaching the subjects. School A had more humanities trained teachers (36.36 per cent; N=12) than School B (33.33 per cent; N=10). However, School B had more teachers (30.00 per cent, N=9) who were teaching humanities than School A (15.15 per cent; N=5).

Only 10.64 per cent (N=10) of the teachers majored in technical subjects, such as Civil Technology and Electrical Technology, and one teacher, 3.23 per cent (N=1) was teaching technical subjects. There was one teacher at School C (3.23 per cent; N=1) who was teaching technical subjects. There were no teachers who were teaching technical subjects at Schools A and B, though there were some teachers who were trained to teach such subjects at both schools. School A had 18.18 per cent (N=6) such teachers but no one was teaching technical subjects. School B had 6.67 per cent (N=2) trained technical subject teachers, and also no one was teaching technical subjects. School C had 6.45 per cent (N=2) such teachers, and 3.23 per cent (N=1) was teaching technical subjects.

There were 12.77 per cent (N=12) teachers who majored in commercial subjects, such as Business Studies and Accounting. 7.45 per cent (N=7) were teaching the subjects. The majority of commercial subjects teachers were at School B (30.00 per cent; N=9) teachers, and 16.67 per cent (N=5) of them were teaching commercial subjects. School C had 6.45 per cent (N=2) who were trained to teach commercial subjects, and both teachers were teaching commercials (6.45 per cent; N=2). School A had 3.03 per cent (N=1) commercial subject trained teachers, but no one was teaching the subjects. It can be concluded that not every teacher who was trained to teach commercial subjects were teaching the subjects.

8.3 ICT access at home

Table 8.3 represents data on ICTs that respondents had access to at home. Individuals with access to ICTs at home are most likely to use the infrastructure at school, if accessible.

Table 8. 3: Access to ICTs at home

ICTs	**Yes (Do have access)**		**No (Do not have access)**		**Total**	**%**
Smart phone	**N**	**%**	**N**	**%**		
School A	33	100.00	00	00.00	33	100.00
School B	29	96.67	1	3.33	30	100.00
School C	27	87.10	4	12.90	31	100.00
Total	**89**	**94.68**	**5**	**5.32**	**94**	**100.00**
A computer						
School A	21	63.64	12	36.36	33	100.00
School B	24	80.00	6	20.00	30	100.00
School C	30	96.77	1	3.23	31	100.00
Total	**75**	**79.79**	**19**	**20.21**	**94**	**100.00**
The internet						
School A	15	45.45	18	54.54	33	100.00
School B	11	36.67	19	63.33	30	100.00
School C	24	77.42	7	22.58	31	100.00
Total	**50**	**53.19**	**44**	**46.81**	**94**	**100.00**
A tablet						
School A	15	45.45	18	54.55	33	100.00

School B	16	53.33	14	46.67	30	100.00
School C	11	35.48	20	64.52	31	100.00
Total	**42**	**44.68**	**52**	**55.32**	**94**	**100.00**

The findings presented in Table 8.3 revealed that most respondents, 94.68 per cent (N=89), had access to a smart phone at home, while 5.32 per cent (N=5) did not have such access. All the respondents from School A owned a smart phone. At School B, 96.97 (N=29) owned a smart phone and only 3.33 per cent (N=1) did not own one. At School C, respondents who owned a smart phone were 87.10 per cent (N=27) and 12.90 per cent (N=4) respondents did not. School C had the least number of respondents who owned a smartphone.

The total percentage of respondents who had access to a computer at home was 79.79 per cent (N=75), while 20.21 per cent (N=19) had no access. The majority of respondents who had access to a computer at home were School C respondents, 96.77 per cent (N=30), and only one respondent, 3.23 per cent (N=1) did not have home access to a computer. At School B, 80.00 per cent (N=24) of the respondents had access to a computer at home, and 20.00 per cent (N=6) did not have such access. School A had the lowest number of respondents who had access to a computer at home, that is 63.65 per cent (N=21), and 36.36 per cent (N=12) had no access.

A total of 53.19 per cent (N=50) of the respondents had access to home internet, while 46.81 per cent (N=44) did not have such access. School C had the majority of respondents who had access to the internet, that is, 77.42 per cent (N=24), and 22.58 per cent (N=7) did not have home internet access. At School A, 45.45 per cent (N=15) of the respondents had access to home internet, while 54.54 per cent (N=18) did not have home internet. At School B only 36.67 per cent (11) had access to the internet at home and 63.33 per cent (N=19) did not have access.

A tablet was a technological device to which the lowest percentage of the respondents had access at home. The total percentage of the respondents who accessed a tablet at home was 44.68 per cent (N=42), while 55.32 per cent

(N=52) did not have such access. Amongst the three schools, School B had most respondents, 53.33 per cent (N=16) who had a tablet at home. School A had 45.45 per cent (N=15) respondents who accessed a tablet at home. School C had the lowest number of respondents accessing a tablet at home, that is, 35.48 per cent (N=11).

It can be deduced, from the findings, that respondents accessed a variety of ICTs at their homes. There was high smart phone access overall and also relatively high access to computers. However, more than a third of respondents at School C did not have access to computers at home. The percentage of respondents who did not have access to the internet was exceptionally high for School B, but at the other two schools less than half of the respondents had home internet.

8.4 Use of ICTs

Teachers' ability to use ICT devices in their daily lives might mean that they can also use such technologies in teaching and learning, if made available.

Table 8.4 below shows data on how often respondents used particular ICT devices in their daily lives.

Table 8. 4: Use of ICT devices

ICTs		**Every day**	**A few times a week**	**A few times a month**	**Less than once a month**	**Never**	**Don't know**	**Total**
		6	**5**	**4**	**3**	**2**	**1**	
A smart phone								
School A	**N** **%**	32 96.97	1 3.03	00 00.00	00 00.00	00 00.00	00 00.00	33 100.00
School B	**N** **%**	29 96.67	00 00.00	00 00.00	00 00.00	1 3.45	00 00.00	30 100.00
School C	**N** **%**	27 87.10	00 00.00	00 00.00	00 00.00	3 9.68	1 3.23	31 100.00
Total	**N** **%**	**88** **93.62**	**1** **1.06**	**00** **00.00**	**00** **00.00**	**4** **4.26**	**1** **1.06**	**94** **100.00**

A computer								
School A	**N** **%**	13 39.39	9 27.27	8 24.24	2 6.06	1 3.03	0 00.00	33 100.00
School B	**N** **%**	8 26.67	13 43.33	6 20.00	00 00.00	3 10.00	00 00.00	30 100.00
School C	**N** **%**	10 32.26	11 35.48	9 29.03	1 3.23	00 00.00	00 00.00	31 100.00
Total	**N** **%**	**31** **32.98**	**33** **35.11**	**23** **24.47**	**3** **3.19**	**4** **4.26**	**00** **00.00**	**94** **100.00**
The internet								
School A	**N** **%**	18 54.55	5 15.15	5 15.15	2 6.06	3 9.09	00 00.00	33 100.00
School B	**N** **%**	7 23.33	17 56.67	2 6.67	1 3.33	3 10.00	00 00.00	30 100.00
School C	**N** **%**	16 51.61	7 22.58	2 6.45	1 3.23	3 9.68	2 6.45	31 100.00
Total	**N** **%**	**41** **43.62**	**29** **30.85**	**9** **9.57**	**4** **4.26**	**9** **9.57**	**2** **2.13**	**94** **100.00**
A tablet								
School A	**N** **%**	17 51.52	3 9.09	3 9.09	7 21.21	3 9.09	00 00.00	33 100.00
School B	**N** **%**	19 63.33	3 10.00	2 6.67	4 13.33	2 6.67	00 00.00	30 100.00
School C	**N** **%**	16 51.61	2 6.45	2 6.45	8 25.81	3 9.68	00 00.00	31 100.00
Total	**N** **%**	**52** **55.32**	**8** **8.51**	**7** **7.45**	**19** **20.21**	**8** **8.51**	**00** **00**	**94** **100.00**

It can be deduced, from Table 8.4, that the majority of respondents, that is 93.62 per cent (N=88) used a smart phone every day. Only 4.26 per cent (N=4) respondents never used a smart phone. One respondent (1.06 per cent) used a smart phone a few times a week and another respondent (1.06 per cent) did not know how often they used a smart phone in their daily lives. Schools A and B had the same percentage of respondents who used a smart phone daily. School A had 96.97 per cent (N=32) and School B also had 96.97 per cent (N=29). School C had 87.10 per cent (N=27) daily users of smart phones. Only one respondent at School A, 3.03 per cent, used a smart phone a few times a week. It was only one respondent, 3.45 per cent (N=1) at School B who never used a smart phone. School C had 9.68 per cent (N=3) respondents who also never used smart phones. One respondent, 3.23 per cent (N=1) at School C did not know how often the responded used a smart phone. Most respondents at the three schools used a smart phone.

Furthermore, a computer was used every day by 32.98 per cent (N=31) of the respondents. Computer usage was notably lower than the use of smartphones. Less than a third of the respondents used computers on a daily basis. School A had the largest number of computer users, that is, 39.39 per cent (N=13), followed by School C which had 32.26 per cent (N=10). School B had the lowest number of respondents that used a computer on a daily basis, that is, 26.67 per cent (N=8). Respondents who used computer a few times a week were 35.11 per cent (N=33). School B had the largest number of respondents who used computers a few times a week, 43.33 per cent (N=13), School C 35.48 per cent (N=11), and School A 27.27 per cent (N=9). A total of 24.47 per cent (N=23) respondents used the computer a few times a month. School C had the largest number of respondents who used the computer a few times a month, that is, 29.03 per cent (N=9), followed by School A, 24.24 per cent (N=8) and School B, 20.00 per cent (N=6). Only 3.19 per cent (N=3) respondents used the computers less than once a month. School A had 6.06 per cent (N=2) respondents and School C had 3.23 per cent (N=1) respondents who used computers less than once a month. No respondent used a computer less than once a month at School B. At all the three schools, no respondent never used a computer. All in all, the number of respondents who used computers was lower than the number of those who used smart phones.

It is further deduced, from Table 8.4, that 43.62 per cent (N=41) respondents used the internet every day. School A had the largest group of respondents, 54.55 (N=18), who used the internet daily. School C had 51.61 per cent (N=16) and the least number was found at School B, 23.33 per cent (N=7). School B also had the lowest number of respondents who used computers on a daily basis. Respondents who used the internet a few times a week were 30.38 per cent (N=29). Most respondents who used the internet a few times a week were at School B, 56.67 per cent (N=17), followed by School C with 22.58 per cent (N=7). School A had the lowest percentage of users who used the internet a few times a week (15.15 per cent; N=5). A total of 9.57 per cent (N=9) respondents used the internet a few times a month. Approximately one tenth of the total sample never used the internet. School A had the largest number, 15.15 per cent (N=5), School B had 6.67 per cent (N=2) and School C, 6.45 per cent (N=2). The internet was used less than once a month by 4.26 per cent (N=4) respondents. School A had 6.06 per cent (N=2), School B 3.33 per cent (N=1) and School C had the least, 3.23 per cent (N=1) respondents who used the internet less than once a month. It was also revealed that 9.57 per cent (N=9) respondents never used the internet in their daily lives. School B had the largest percentage, 10.00 per cent (N=3), followed by School C, 9.68 per cent (N=3) then lastly School A, 9.09 (N=3). Respondents who did not know how often that they used the internet in their daily lives were 2.13 per cent (N=2), and these were all at School C. It can be concluded that respondents accessed the internet more than the computer. However, respondents who used a computer and the internet were fewer than those who accessed a smart phone.

Respondents who indicated that they used the tablet daily were 55.32 per cent (N=52). The largest percentage was at School B, 63.33 per cent (N=19), followed by School C, with 51.61 per cent (N=16) and lastly School A, 51.52 per cent (N=17).

A total of 8.51 per cent (N=8) respondents used tablets a few times a week. School B had the largest percentage, 10.00 per cent (N=3), followed by School A, 9.09 per cent (N=3) and then School C, 6.45 per cent (N=2). Respondents who used a tablet a few times a month were 7.45 per cent (N=7). School A had the largest number, 9.09 (N=3) respondents, School B, 6.67 per cent (N=2) and lastly School C, 6.45 per cent (N=2) such respondents. Some respondents used tablets less than once a month and those were a total of 20.21 per cent (N=19) respondents. School C had the largest percentage of respondents who used a tablet less than a month, that is, 25.81 per cent (N=8), School A, 21.21 per cent (N=7) and School B had 13.33 per cent (N=4). A total of 8.51 per cent (N=8) respondents never used a tablet in their daily lives. School C had the largest percentage, 9.68 per cent (N=3), followed by School A, 9.09 per cent (N=3), and School B had the least percentage, 6.67 per cent (N=2).

It can be concluded that respondents did not have access to all ICTs included in this study. Most respondents often used the smart phone, followed by the tablet, then the internet, and lastly the computer.

Table 8. 5: Mean scores for use of ICTs in daily activities

Use in your daily activities	School A N=33		School B N=30		School C N= 31		Total N=94	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Smart phone	4.97	0.174	4.87	0.73	4.60	1.22	4.82	0.82
Computer	3.94	1.09	3.77	1.17	3.97	0.88	3.89	1.04
Internet	4.00	1.35	3.80	1.16	4.10	1.32	3.97	1.27
Tablet	3.73	1.51	4.10	1.37	3.65	1.56	3.82	1.48

Overall, it can be deduced from Table 8.5 that there was a moderate to high usage of the four ICTs by teachers, as indicated by the total mean scores of all the ICT devices, which ranged from a total of 3.82 to 4.82.and were thus all above the scale midpoint. The ICT device which indicated the total highest mean score was a smartphone, 4.82 (sd=0.82), signifying a high usage of the device. School A had the majority of such teachers, with a mean score of 4.97 (sd=0.17) followed by School B, 4.87 (sd=0.73) then lastly School C, with a mean score 4.60 (sd=1.22). Computers were also moderately used by the teachers, as indicated by the total mean score, 3.89 (sd=1.04). All the three schools had mean scores above the scale midpoint 3 but below 4, which is indicative of a moderate usage of computers.

The internet was also moderately used by most teachers at the three schools, with a total of 3.97 mean score and standard deviation 1.27. However, Schools A and C used the internet the most as indicated by the mean scores of 4.00 (sd=1.35) and 4.10 (sd=1.32), respectively. School B had the lowest mean score, 3.80 (sd=1.16), which is indicative of moderate usage of the internet. The tablet was another device which was also moderately used by teachers, with a total mean score of 3.82 (sd=1.48). School B recorded the highest mean score for tablet use, 4.10 (sd=1.37) indicating high use of this device. Both Schools A and C had mean scores above midpoint 3 but below 4, indicating a moderate usage of the device.

8.5 The availability of ICTs for teaching and learning at schools

The availability of ICTs for teaching and learning is a pre-requisite if respondents are to adopt and use the ICTs in the classroom. In order to solicit data on the first sub-research objective, teachers were asked to identify technologies available for teaching and learning at schools. Table 8.6 shows results on identified technologies available for teaching and learning.

Table 8. 6: ICT devices available for teaching and learning

Available ICTs	Yes		No		Total	
	N	%	N	%	N	%
Computers in working order for teachers' use						
School A	21	63.63	12	36.36	33	100.00
School B	19	63.33	11	36.67	30	100.00
School C	22	70.97	9	29.03	31	100.00
Total	**62**	**66.00**	**32**	**34.00**	**94**	**100.00**
Interactive whiteboards which can be used by any teacher during teaching						
School A	10	30.30	23	69.70	33	100.00
School B	16	53.33	14	46.67	30	100.00
School C	14	45.16	17	54.84	31	100.00
Total	**40**	**42.60**	**54**	**57.40**	**94**	**100.00**

It can be deduced, from the data in Table 8.6, that 66.00 cent (N=62) of the total sample indicated that there were computers in working order at their schools and 42.60 per cent (N=40) of the respondents indicated that there were whiteboards which could be used by any respondent during teaching and learning. Teachers who indicated that there were computers in working order (66.00 per cent; N=62) were more than those (42.60 per cent; N=40) who concurred that there were interactive whiteboards available for teaching learning.

School C had the largest percentage of respondents who indicated that there were functional computers, that is 70.97 per cent (N=22), followed by School A, 63.63 per cent (N=21) respondents, and lastly School B, 63.33 per cent (N=19). Hence the availability of computers was the lowest at School B. On the other hand, 34.00 per cent (N=32) respondents indicated that there were no computers in good working order for use. School B had the largest percentage of such respondents, 36.67 per cent (N=11), then School A, 36.36 per cent (N=12), and School C, 29.03 per cent (N=9). It can be said that most respondents had access to computers for teaching and learning at all the three schools.

Furthermore, School B had 53.33 per cent (N=16) respondents, School C, 45.16 per cent (N=14) and School A had 30.30 per cent (N=10), respondents who concurred that interactive whiteboards were available for use by any respondent. However, there were 57.40 per cent (N=54) respondents who indicated that there were no interactive whiteboards available for the respondents to use. School A had the largest percentage of respondents, 69.70 per cent (N=23), School C 54.84 per cent (N=17) and, School B 46.67 per cent (N=14). Overall, the availability of interactive whiteboards was highest at School B. Slightly above half of the respondents had access to whiteboards at School B. It can be concluded that most respondents had limited access to interactive whiteboards.

8.6 Respondent readiness to use identified ICTs in teaching and learning

The second sub-research objective of this study investigates teacher readiness to use identified technologies in the classroom. Therefore, Table 8.7 presents quantitative results on teacher readiness to use identified ICTs in teaching and learning.

Table 8. 7: Respondents' level of ICT skills

ICT skills	**Excellent**		**Good**		**Fair capability**		**Low capability**		**No capability**		**Total**	
	5		**4**		**3**		**3**		**1**			
Word processing	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
School A	4	12.12	17	51.52	8	24.24	2	6.06	2	6.06	33	100.00
School B	7	23.33	18	60.00	2	6.67	2	6.67	1	3.33	30	100.00
School C	6	19.35	18	58.06	4	12.90	00	00.00	3	9.68	31	100.00
Total	**17**	**18.09**	**53**	**56.38**	**14**	**14.89**	**4**	**4.26**	**6**	**6.38**	**94**	**100.00**

Spreadsheets						
School A	3 9.09	9 27.27	11 33.33	6 18.18	4 12.12	33 100.00
School B	1 3.33	8 26.67	15 50.00	5 16.13	1 3.33	30 100.00
School C	5 16.13	5 16.13	7 22.81	8 25.81	6 19.35	31 100.00
Total	**9 9.57**	**22 23.40**	**33 53.11**	**19 20.21**	**11 11.70**	**94 100.00**
Presentation tools						
School A	3 9.09	16 48.48	6 18.18	6 18.18	2 6.06	33 100.00
School B	2 6.67	15 50.00	8 26.67	4 13.33	1 3.33	30 100.00
School C	3 9.68	10 32.26	7 22.58	8 25.81	3 9.68	31 100.00
Total	**8 8.51**	**41 43.62**	**21 22.34**	**18 19.15**	**6 6.38**	**94 100.00**
e-mailing						
School A	14 42.42	6 18.18	2 6.06	9 27.27	2 6.06	33 100.00
School B	14 46.67	7 23.33	3 10.00	5 16.67	1 3.33	30 100.00
School C	10 32.26	11 35.48	3 9.68	6 19.35	1 3.23	31 100.00
Total	**38 40.43**	**24 25.53**	**8 8.51**	**20 21.28**	**4 4.26**	**94 100.00**
Internet browsing						
School A	13 39.39	7 21.21	8 24.24	2 6.06	3 9.06	33 100.00
School B	13 43.33	9 30.30	3 10.00	4 13.33	1 3.33	30 100.00
School C	10 32.26	11 35.48	4 12.90	5 16.13	1 3.23	31 100.00
Total	**36 38.30**	**27 28.72**	**15 15.96**	**11 11.70**	**5 5.32**	**94 100.00**
Statistical tools						
School A	00 00.00	4 12.12	11 33.33	11 33.33	7 21.21	33 100.00
School B	3 10.00	6 20.00	11 36.67	8 26.67	2 6.67	30 100.00
School C	00 00.00	2 6.45	4 12.90	17 54.84	8 25.81	31 100.00
Total	**3 3.19**	**12 12.77**	**26 28.46**	**36 38.30**	**17 18.09**	**94 100.00**

It can be deduced, from the data in Table 8.7, that 18.09 per cent (N=17) respondents had excellent word processing skills. The largest percentage of these respondents was from School B which had 23.33 per cent (N=7). School C had 19.35 per cent (N=6) and School A 12.12 per cent (N=4) such respondents. The majority of the respondents, 56.38 per cent (N=53) had good word processing skills. Most of those respondents were from School B, 60.00 per cent (N=18), followed by School C, 58.06 per cent (N=18), and lastly School A, which had 51.52 per cent (N=17). A total of 14.89 per cent (N=14) respondents had fair skills. School A had 24.24 per cent (N=8), School C 12.90 per cent (N=4), and School B, 6.67 per cent (N=2) such respondents. Schools A and B had respondents with low capability in word processing. School A had 6.06 per cent (N=2) and School B 6.67 per cent (N=2). No respondents at School C indicated

that they had low word processing skills. There was a total of 6.38 per cent (N=6) respondents who indicated that they had no capability at all. The largest percentage was from School C, 9.68 per cent (N=3), followed by School A, 6.06 per cent (N=2), and lastly School B, 3.33 per cent (N=1). Most of the respondents were thus of the opinion that they had good to excellent Word processing skills.
Furthermore, only 9.57 per cent (N=9) respondents indicated that they had excellent spreadsheets skills. Most of these respondents were from School C, 16.13 per cent (N=5), then School A, 9.09 per cent (N=3) and School B, 3.33 per cent (N=1). A total of 23.40 per cent (N=22) respondents said that they had good spreadsheet skills. Most of them were School A respondents, 27.27 (N=9), School B had 26.67 per cent (N=8), and School C 16.13 per cent (N=5) such respondents.

Most respondents indicated that they had fair skills, that is, 53.11 per cent (N=33). The largest number of that group was from School B, 50.00 per cent (N=15), School A, 33.33 per cent (N=11), and School C, 22.81 per cent (N=7) such respondents.

Respondents who indicated that they had low levels of spreadsheet skills were 20.21 per cent (N=19). School C constituted the majority of these respondents, with 25.81 per cent (N=8), School A 18.18 per cent (N=6), and School B 16.13 per cent (N=5). There were 11.70 per cent (N=11) respondents who had no capability at all in spreadsheets. School C had 19.35 per cent (N=6), School A 12.12 per cent (N=4), and School B 3.33 per cent (N=1) such respondents. It can, thus, be said that most respondents had low to no capability at spreadsheet skills.

It can further be deduced, from the same table, that 8.7 per cent (N=8) respondents felt that they had excellent presentation skills. At School C there were 9.68 per cent (N=3), School A 9.09 per cent (N=3), and School B 6.67 per cent (N=2) such respondents. Most respondents, however, indicated that they had good rather than excellent presentation skills, that is, 43.62 per cent (N=41). The majority of these respondents were from School B, that is, 50.00 per cent (N=15), then School A, 48.48 per cent (N=16), and School C, 32.26 per cent (N=10). Respondents who had fair skills were 22.34 per cent (N=21). Most of them were from School B, 26.67 per cent (N=8), then School C, 22.58 per cent (N=7) and School A, 18.18 per cent (N=6). Respondents who indicated that they had low capability skill were 19.15 per cent (N=18). School C had 25.81 per cent (N=8), School A, 18.18 per cent (N=6) and School B, 13.33 per cent (N=4) such respondents. Only 6.38 per cent (N=6) respondents indicated that they had no capability at all. Most of these respondents were from School C, 9.68 per cent (N=3), then School A, 6.06 per cent (N=2), and lastly School B, 3.33 per cent (N=1). It can, therefore, be deduced that almost half of the total respondents had good to excellent presentation skills. The rest had fair to no capability at all.

Respondents who indicated that they had excellent emailing skills were 40.43 per cent (N=38). Most of these respondents were from School B, 46.67 per cent (N=14), School A had 42.42 per cent (N=14) and lastly, School C 32.26 per cent (N=10) such respondents. Respondents who had good emailing skills were 25.53 per cent (N=24). At School C, they were 35.48 per cent (N=11), School B had 23.33 per cent (N=7) and School A 18.18 per cent (N=6) respondents with good emailing skills. Respondents with fair capability were 8.35 per cent (N=8). School B had 10.00 per cent (N=3), School C 9.68 per cent (N=3), and School A 6.06 per cent (N=2) such respondents. Those with low capability were 21.28 per cent (N=20). School A had 27.27 per cent (N=9), School C 19.35 per cent (N=6), and School B 16.67 per cent (N=5) respondents who had low capability. Only a total of 4.26 per cent (N=4) respondents had no emailing capability at all. Most of them were School A respondents, that is, 6.06 per cent (N=2), then School B 3.33 per cent (N=1), and School C 3.23 per cent (N=1). Most of the respondents had excellent to good internet skills. Almost the same numbers of respondents at the three schools had low to no capability at all.

Respondents who indicated that they had excellent internet browsing skills were 38.30 per cent (N=36). School B had 43.33 per cent (N=13), School A 39.39 per cent (N=13), and School C 32.26 per cent (N=13) such respondents. Respondents with good skills were 28.72 per cent (N=27) of the total sample. Most of these respondents were School C respondents, that is, 35.48 per cent (N=11), then School B, 30.30 per cent (N=9), and lastly School A 21.21 per cent

(N=7). Those who indicated fair capability were 15.96 per cent (N=15). At School A, there were 24.24 per cent (N=8), at School C 12.90 per cent (N4), and School B 10.00 per cent (N=3) such respondents. Respondents who lowly rated their internet browsing skills were 11.70 per cent (N=11). School C had the largest number, 16.13 per cent (N=5), followed by School B, 13.33 per cent (N=4) and then School A, 6.06 per cent (N=2). Only 5.32 per cent (N=5) of the respondents said that they had no internet browsing capability at all. Most of them were from School A, 9.09 per cent (N=3), then School B 3.33 per cent (N=1), and School C 3.23 per cent (N=1). Most respondents from all the three schools had similar internet browsing skills.

Only three, 3.19 per cent (N=3) of the total sample of respondents indicated that they had excellent statistical tools skills. All three were School B respondents, that is, 10.00 per cent. A total of 12.77 per cent (N=12) of the respondents said that they had good statistical analysis skills, most of whom were School B respondents, 20.00 per cent (N=6), then School A, 12.12 per cent (N=4) and School C, 6.45 per cent (N=2). Respondents who indicated that they had fair levels were 28.46 per cent (N=26). The largest percentage of them were School B respondents, that is, 36.67 per cent (N=11), then School A, 33.33 per cent (N=11), and School C, 12.90 per cent (N=4). Respondents who indicated that they had low capability were 38.30 per cent (N=36). Most of them were School C respondents, that is, 54.84 per cent (N=17), then School A, 33.33 per cent (N=11), and School B, 26.67 per cent (N=8). There were some respondents, 18.09 per cent (N=17) who rated themselves not to have any statistical tools. School C respondents, 25.81 per cent (N=8) constituted most of them, followed by School A, 21.21 per cent (N=7) and lastly School B, 6.67 per cent (N=2). It can, therefore, be concluded that School B respondents had better statistical tools skills than the other respondents from Schools A and C.

It can be argued that respondents at the three schools had varied level of ICT skills. Some of them did not have any skills at all. This research study did not only request the respondents to rate their ICT skills, but further explored how often they used the ICT skills that they had in teaching and learning. This is addressed in Table 8.11.

Table 8. 8: Mean scores for respondents' levels of ICT skills

ICT skills	School A N=33		School B N=30		School C N=31		Total N=94	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Word processing	3.58	1.00	3.93	0.94	3.77	1.09	3.76	1.01
Spreadsheets	3.03	1.16	3.10	0.85	2.84	1.37	2.99	1.14
Presentation tools	3.36	1.08	3.43	0.93	3.06	1.18	3.29	1.07
Emailing	3.58	1.23	3.93	1.26	3.74	1.21	3.84	1.22
Internet browsing	3.76	13.00	3.67	1.19	3.77	1.18	3.83	1.22
Statistical tools	2.36	0.96	3.00	1.08	2.00	0.82	2.45	1.03

All in all, four items (presentation tools, word processing, internet browsing and emailing) out of six had mean scores ranging from 3.29 to 3.84, indicating that teachers had moderate skills levels for some ICTs. The other two items (Statistical tools and Spreadsheets) had mean scores which ranged from 2.45 to 2.99, indicating relatively low ICT skills levels.

Though the total mean score for Spreadsheets was low, m=2.99 (sd=1.14), indicating limited skills, Schools A and B had mean scores above the scale midpoint 3 but below 4, indicating that those teachers had moderate Spreadsheet skills. It was, thus, only School C teachers who had relatively low levels of the particular skill. Teachers at the three schools had low levels of Statistical tools skills as indicated by a total mean score of 2.45 (sd=1.03). However, School B teachers had moderate skills level, as indicated by a mean score of 3.00 (sd=1.83). Both Schools A and C had low mean scores, which was an indication of low levels of Statistical tools.

Table 8. 9 Results of the factor analysis for ICT skills

	Factor 1
	1
B2.1 Level of ICT Skills- Word processing	.848
B2.2 Level of ICT Skills- Spreadsheets	.610
B2.3 Level of ICT Skills- Presentation tools	.855
B2.4 Level of ICT Skills- Emailing	.833
B2.5 Level of ICT Skills- Internet browsing	.880
B2.6 Level of ICT Skills- Statistical tools	.703

A principal factor analysis with varimax rotation was conducted. Only factor loadings of 0.4 or above were taken into account. As indicated in Table 8.9, only one factor was extracted, which explained 63.038% of the variance. All the ICT skills investigated loaded on this factor. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was a satisfactory 0.811, indicating that a problem with multi-collinearity is unlikely. A composite scale -ICT Skills- was consequently computed. The Cronbach alpha for this scale is a satisfactory .878. Scores could vary between 30 and 5 and higher scores are indicative of a higher skills level.

Table 8. 10: Mean scores for composite ICT Skills scale

School	Mean	Std. Deviation	N
A	19.94	5.984	33
B	21.37	5.041	30
C	19.19	4.636	31
Total	20.15	5.289	94

The mean scores and standard deviations for the composite ICT Skills scale are reported in Table 8. 10. Although School B had the highest mean score, a one-way analysis of variance (ANOVA) indicates no statistical significant differences between the three schools ($F(2, 34)=1.336$; $p=.268$; eta=.0.29). As the scale midpoint can be regarded as 15, it can be deduced that teachers at all three schools had fairly good – but not excellent – ICT skills.

Univariate analysis of variance (ANOVA) with post-hoc Scheffe tests were further conducted to see whether differences in ICT skills existed with regard to the following demographic variables: gender, age, highest education qualification and teachers' years of experience. (The rank of teachers could, unfortunately, not be included in the model due to a high number of missing values.) The results of the ANOVA for the overall model indicates the presence of statistical significant differences: ($F(26,92)=6.357$; $p=.000$; eta=.718). The effect size indicates an effect of 7.18%. The two significant predictors were age ($p=.002$) and teachers' years of experience, as well as the interaction between age and years of experience ($p=.013$). The post-hoc Scheffe tests indicated two homogeneous subsets for age. Teachers of 46 years old and older had significantly lower ICT skills than teachers in the two younger age categories (36 to 45 years and 24 to 35 years). Three homogeneous subsets were indicated for years of experience: teachers with ten years or less experience indicated significantly higher ICT skills than teachers with more years of experience. Although teachers with 11 to 21 years of experience had significantly lower ICT skills than those with ten or less years of experience, their skills were significantly better than the teachers with 22 and more years of experience. The latter group had the lowest level of experience. The significance of the interaction between age and years of experience could be ascribed to the fact that the older teachers generally had more experience.

8.7 ICTs usage in teaching

Constant use or otherwise of the available ICTs in the classroom might be an indication of the degree of teacher readiness to adopt the technologies in teaching and learning (sub-research objective two). Table 8.11 presents data on respondents' responses on how often they used the available ICTs in teaching.

Table 8. 11: Use of ICTs in teaching

ICTs use in teaching	All the time		Often		Sometimes		Seldom		Not at all		Total	
	5		**4**		**3**		**2**		**1**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Computers												
School A	3	9.38	7	21.88	5	15.63	3	9.38	14	43.75	32	100.00
School B	3	10.00	13	43.33	3	10.00	0	00.00	11	36.67	30	100.00
School C	0	00.00	10	32.26	8	25.81	3	9.68	10	32.26	31	100.00
Total	**6**	**6.45**	**30**	**32.26**	**16**	**18.20**	**6**	**6.45**	**35**	**38.43**	**93**	**98.94**
An interactive whiteboard												
School A	0	00.00	8	24.24	3	9.09	3	9.09	19	57.58	33	100.00
School B	3	10.00	12	40.00	1	3.33	0	00.00	14	46.67	30	100.00
School C	11	35.48	9	29.03	0	00.00	1	3.23	10	32.26	31	100.00
Total	**14**	**14.89**	**29**	**30.85**	**4**	**4.26**	**4**	**4.26**	**43**	**45.74**	**94**	**100.00**

It can be deduced, from the data in Table 8.11, that the largest percentages of respondents - almost half in the case of whiteboards- never used these devices in their teaching. The lowest usage of whiteboards was at School A.

Only 6.45 per cent (N=6) of the total respondents used computers all the time in the classroom. No respondent used the computers all the time at School C. School B had 10.00 per cent (N=3), and School A 9.09 per cent (N=3) respondents who used the computers all the time in teaching. Those who often used the computers were 32.98 per cent (N=31). Most of them were School B respondents, 43.33 per cent (N=13). School C had 32.26 per cent (N=10), and School A 24.24 per cent (N=8) respondents who often used computers. A total number of 18.20 per cent (N=16) respondents sometimes used the computers in teaching. School C had 25.81 per cent (N=8), School A 15.15 per cent (N=5), and then School B 10.00 per cent (N=3). Those who seldom used the computer in teaching were 6.45 per cent (N=6). School C had 9.68 per cent (N=3) and School A 9.09 per cent (N=3) respondents who seldom used the computer. No respondent seldom used the computer at School B. A total number of 38.43 per cent (N=35) respondents never used the computer at all in teaching. The largest number of these respondents were at School A, 42.42 per cent (N=14), followed by School B, 36.67 per cent and lastly School C, 32.26 per cent (N=10). It can, thus, be said that limited accessibility to the ICT infrastructure might be a hindrance to the use of computers in teaching.

Only 14.89 per cent (N=14) of the total sample used the interactive whiteboard all the time to teach learners. School C had the largest number, that is, 35.48 per cent (N=11) and School B had 10.00 per cent (N=3). No respondent used the interactive whiteboard all the time in teaching at School A. There were 30.55 per cent (N=29) respondents of the total sample who often used the interactive whiteboard in teaching. School B had 40.00 per cent (N=12) respondents who often used the interactive whiteboard, School C 29.03 per cent (N=9), and School A 24.24 per cent (N=8) such respondents. A total of 4.26 per cent (N=4) respondents sometimes used the interactive white board in teaching. School A had 9.09 per cent (N=3), and School B 3.33 per cent (N=1) users, whereas at School C, no respondent sometimes used the interactive whiteboard. Respondents who seldom used the interactive whiteboard were also 4.26 per cent (N=4) of the total sample. School A had 9.09 per cent (N=3), and School C 3.23 per cent (N=1) respondents who seldom used the smart board. No respondent seldom used the smart board at School B. The largest percentages of the respondents, that is, 45.74 per cent (N=43) never used an interactive whiteboard at all in teaching. School A had 57.58 per cent (N=19), School B 46.67 per cent (N=14) and School C 32.26 per cent (N=10) respondents who never used the smart board at all.

Table 8. 12: Mean scores for use of ICTs in teaching

Use of ICTs in teaching	**School A N=33**		**School B N=30**		**School C N=31**		**Total N=94**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Computers	2.44	1.48	2.90	1.54	2.58	1.26	2.63	1.43
An interactive whiteboard	2.00	1.30	2.67	1.63	3.32	1.74	2.65	1.64

Computers and interactive whiteboards were used to a limited extent by teachers at all the three schools, as indicated by total mean scores of 2.63 (sd=1.26) and 2.65 (sd=1.64) respectively. School C had a mean score of 3.32 (sd=1.74), indicating a moderate use of interactive whiteboards in teaching.

8.8 Integration of ICTs in teaching and learning

In order to establish teacher readiness to use identified technologies in the classroom (sub-research objective two), teachers were asked the extent that they integrated ICTs in teaching and learning. Table 8.13 presents data on the respondents' responses on the extent to which they integrated ICTs in teaching.

Table 8. 13: Integration of ICTs in teaching

ICTs integration	To a large extent		To a reasonable extent		To a small extent		Not at all		Total	
	5		4		3		2		1	
	N	%	N	%	N	%	N	%	N	%
I am aware of ICTs available for teaching and learning										
School A	32	96.97	2	6.06	00	00.00	00	00.00	33	100.00
School B	26	86.67	2	6.67	00	00.00	1	3.33	30	100.00
School C	30	96.77	1	3.23	00	00.00	00	00.00	31	100.00
Total	**88**	**93.62**	**5**	**5.32**	**00**	**00.00**	**1**	**1.06**	**94**	**100.00**
I use various ICTs in my teaching										
School A	14	42.42	19	57.58	00	00.00	00	00.00	33	100.00
School B	16	53.33	13	43.33	00	00.00	1	3.33	30	100.00
School C	18	58.06	12	38.71	1	3.23	00	00.00	31	100.00
Total	**48**	**30.19**	**44**	**46.81**	**1**	**1.06**	**1**	**1.06**	**94**	**100.00**
I have access to ICTs that I use in my teaching and learning										
School A	13	39.39	20	60.61	00	00.00	00	00.00	33	100.00
School B	16	53.33	14	46.67	00	00.00	00	00.00	30	100.00
School C	16	51.61	14	45.16	1	3.23	00	00.00	31	100.00
Total	**45**	**47.87**	**48**	**51.06**	**1**	**1.06**	**00**	**00.00**	**94**	**100.00**
I know how to integrate ICTs in my teaching and learning										

School A	18	54.55	15	45.45	00	00.00	00	00.00	33	100.00
School B	21	70.00	9	30.00	00	00.00	00	00.00	30	100.00
School C	14	45.16	16	51.61	1	3.23	00	00.00	31	100.00
Total	**53**	**56.38**	**40**	**42.55**	**1**	**1.06**	**00**	**00.00**	**94**	**100.00**
I use ICTs to actively engage learners										
School A	14	42.42	19	57.58	00	00.00	00	00.00	33	100.00
School B	15	50.00	15	50.00	00	00.00	00	00.00	30	100.00
School C	17	54.84	13	41.94	1	3.23	00	00.00	31	100.00
Total	**46**	**48.94**	**47**	**50.00**	**1**	**1.06**	**00**	**00.00**	**94**	**100.00**
I use ICTs to promote learner to learner interaction (e.g. interaction between learners) during the lesson										
School A	13	39.39	20	60.61	00	00.00	00	00.00	33	100.00
School B	15	50.00	15	50.00	00	00.00	00	00.00	30	100.00
School C	14	45.16	16	51.62	1	3.23	00	00.00	31	100.00
Total	**42**	**46.67**	**51**	**54.26**	**1**	**1.06**	**00**	**00.00**	**94**	**100.00**
I have adequate ICT skills to enable me to use technology in my teaching and learning										
School A	18	54.55	16	48.48	00	00.00	00	00.00	33	100.00
School B	12	40.00	17	56.67	00	00.00	00	00.00	30	100.00
School C	18	58.06	12	38.71	1	3.23	00	00.00	31	100.00
Total	**48**	**51.06**	**45**	**47.87**	**1**	**1.06**	**00**	**00.00**	**94**	**100.00**

It can be deduced, from data in Table 8.13, that overall, the majority of the respondents, 93.62 per cent (N=88), indicated that they were aware of ICTs available for teaching and learning to a large extent. Most of these respondents were from School A, 96.97 per cent (N=32), followed by School C which had 96.77 per cent (N=30), and then School B 86.67 per cent (N=26). Those who were aware to a reasonable extent were 5.32 per cent (N=5) of the total sample.

The largest percentage was from School B respondents, that is, 6.67 per cent (N=2), School A 6.06 per cent (N=2) and School C had 3.23 per cent (N=1). Only 3.33 per cent (N=1) respondent at School B was not aware of ICTs available for teaching.

It can further be deduced that 30.19 per cent (N=48) of the total sample was using various ICTs in teaching to a large extent. At School C this was the case for 58.06 per cent (N=18) of the respondents. School B had 15.33 per cent (N=16), and School A 42.42 per cent (N=14) respondents who used ICTs to a large extent. Those who used a variety of ICTs to a reasonable extent were 46.81 per cent (N=44) of the total sample. The largest percentage was from School A respondents, 57.58 per cent (N=19), then School B 43.33 per cent (N=13), and lastly School C, with 38.71 per cent (N=12). Only 1.06 per cent (N=1) respondent at School C used ICTs in teaching to a small extent. Also, only 3.33 per cent (N=1) respondent at School B was not using various ICTs at all in teaching.

Respondents who had access to ICTs that they used in teaching to a large extent were a total of 47.87 per cent (N=45). Most of them were School B respondents, 53.33 per cent (N=16), followed by School C, 51.61 per cent (N=16), and lastly School A, 39.39 per cent (N=13). Those who had access to a reasonable extent were 51.06 per cent (N=48) of the total sample. At School A this was the case for 60.61 per cent (N=20). School B had 46.47 per cent (N=14) and School C, 45.16 per cent (N=14) respondents who accessed ICTs at a reasonable extent. A respondent at School C, 1. 06 per cent (N=1), had accessed ICTs to a small extent and there were no such respondents at both Schools A and B.

Respondents who responded that they knew how to integrate ICTs in the classroom to a large extent were 56.38 per cent (N=53) of the total sample. The largest percentage of such respondents was at School B, that is, 70.00 per cent (N=21). School A had 54.55 per cent (N=18) and School C had the smallest percentage, 45.16 per cent (N=14) of respondents who knew how to integrate ICTs in teaching to a large extent. Those who knew how to integrate ICTs to a reasonable extent were a total of 42.55 per cent (N=40) respondents. School C had the majority, at 51.61 per cent (N=16), followed by School A, 45.45 per cent (N=15), and then School B, 30.00 per cent (N=9). There was only 1.06 per cent (N=1) respondent at School C who knew how to integrate ICTs in teaching and learning to a small extent. There were no such respondents at School A and School B.

It can also be deduced, from the same Table 8.13, that some respondents, 48.98 per cent (N=46) of the total sample used ICTs to actively engage learners in teaching and learning to a large extent. The largest percentage of such respondents were at School C, 54.84 per cent (N=17), then School B, 50.00 per cent (N=15), and School A, 42.42 per cent (N=14). Respondents who actively engaged learners to a reasonable extent were a total of 50.00 per cent (N=47). School A had the largest percentage, that is, 57.58 per cent (N=19), then School B had 50.00 per cent (N=15) and lastly School C, 41.94 per cent (N=13) such respondents. A respondent at School C, 3. 23 per cent (N=1), used ICTs to actively engage learners to a small extent. There were no such respondents at both School A and B.

A total of 46.67 per cent (N=42) respondents used ICTs to promote learner to learner interaction to a large extent. School B had the largest percentage, 50.00 per cent (N=15), followed by School C, 45.16 per cent (N=14), and School A, 39.38 per cent (N=13) such respondents. Those who promoted learner to learner interaction to a reasonable extent were 54.26 per cent (N=51) of the total sample. School A had the largest percentage, that is, 60.61 per cent (N=20), followed by School C with 51.62 per cent (N=16), and lastly School B, 50.00 per cent (N=15). There was a respondent, 3.23 per cent (N=1) at School C who indicated that use of ICTs to a small extent to promote learner to learner interaction. There were no such respondents at Schools A and B.

51.06 per cent (N=48) of the total sample agreed that they had adequate ICT skills which enabled them to use ICTs to a large extent in teaching and learning. School C had the largest percentage of such respondents, that is, 58.06 per cent (N=18), then School A, 54.55 per cent (N=18), and lastly School B, 40.00 per cent

(N=12). Those who had adequate ICT skills to a reasonable extent were 47.87 per cent (N=45) of the total sample. School B had the largest percentage of such teachers, that is, 56.67 per cent (N=17), followed by School A which had 48.48 per cent (N=16), and lastly School C had 38.71 per cent (N=12). There was only one respondent at School C, 3.23 per cent (N=1), who indicated having adequate ICT skills to a small extent. There were no such respondents at Schools A and B.

Table 8. 14: Mean scores for integration of ICTs in teaching

ICTs integration	School A N=33		School B N=30		School C N=31		Total N=94	
	M	SD	M	SD	M	SD	M	SD
I am aware of ICTs available for teaching and learning	3.97	0.17	3.80	0.61	3.97	0.18	3.91	0.38
I use various ICTs in my teaching	3.42	0.50	3.47	0.68	3.55	0.57	3.48	0.58
I have access to ICTs that I use in my teaching and learning	3.39	0.50	3.53	0.51	3.48	0.57	3.47	0.52
I know how to integrate ICTs in my teaching and learning	3.55	0.51	3.70	0.47	3.42	0.56	3.55	0.52
I use ICTs to actively engage learners	3.42	0.50	3.50	0.51	3.52	0.57	3.48	0.52
I use ICTs to promote learner to learner interaction (e.g. interaction between learners) during the lesson	3.39	0.50	3.50	0.51	3.42	0.56	3.44	0.52
I have adequate ICT skills to enable me to use technology in my teaching and learning	3.52	0.51	3.43	0.51	3.55	0.57	3.50	0.52

Overall, it can be deduced, from Table 8.14 that the total mean scores for the integration of ICTs ranged from 3.44 to 3.91, indicating a moderate integration of ICTs in teaching. The mean scores for all seven items were largely similar at the three schools.

A total mean score of 3.91 (sd=0.38) indicates that teachers were aware of ICTs available for teaching and learning to a moderate extent. Schools A (sd=0.17) and C (sd=0.18) shared the same mean score, m=3.97, signifying a moderate awareness of ICTs available for teaching. There was a moderate use of various ICTs in teaching at the three schools as indicated by a total mean score of 3.84 (sd=0.58). School C had the highest mean score of 3.55 (sd=0.57), indicating a moderate usage of various ICTs in teaching at the school. It can further be deduced, from Table 8.12, that teachers had access to ICTs that they used in teaching to a reasonable extent, as indicated by a mean score of 3.47 (sd=0.52). School B had the highest mean score of 3.53 (sd=0.51), signifying also a moderate access to ICTs teachers used in teaching. A total mean score of 3.55 (sd=0.52) indicates that teachers at the three schools knew how to integrate ICTs in their teaching to a moderate extent. Of the three schools, School B had the highest mean score, 3.70 (sd=0.47), indicating that teachers had knowledge of how to integrate ICTs to a moderate extent. A total mean score of 3.48 (sd=0.52) indicates that teachers used ICTs to actively engage learners to a reasonable extent. School C had the highest mean score of 3.52 (sd=0.57), signifying that teachers used of ICTs to actively engage learners to a moderate extent. Furthermore, a total mean score of 3.44 (sd=0.52) indicates that there was a reasonable use of ICTs among teachers to promote learner to learner interaction. School B had the highest mean score, 3.50 (sd=0.51), indicating that teachers used ICTs to promote learner to learner interaction to a moderate extent. School C teachers had a mean score of 3.55 (sd=0.57), indicating that they had adequate ICT skills to use technology in teaching and learning to a moderate extent. School A respondents also had such skills to a moderate extent, as indicated by a mean score of 3.52 (sd=0.51).

8.9 Purposes for which, and how respondents were using ICTs in their teaching

In order to answer the third sub-research question on factors that influenced the integration of ICTs in teaching and learning, teachers were asked their readiness to use ICTs in teaching. Table 8.15 presents' data on how often respondents use computer applications in teaching.

Table 8. 15: Use of computer applications in teaching

Computer application	All the time		Often		Sometimes		Seldom		Never		Total	
	5		**4**		**3**		**2**		**1**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Use of spreadsheets (e.g. excel)												
School A	1	3.03	4	12.12	1	3.03	15	45.45	12	36.36	33	100.00
School B	1	3.33	9	30.30	5	16.67	10	33.33	5	16.67	30	100.00
School C	0	00.00	2	6.45	3	9.68	15	48.39	11	35.48	31	100.00
Total	**2**	**2.13**	**15**	**15.96**	**9**	**9.57**	**40**	**42.55**	**28**	**29.79**	**94**	**100.00**
Use of internet browsing												
School A	9	27.27	11	33.33	2	6.06	2	6.06	9	27.27	33	100.00
School B	5	17.24	11	37.93	7	24.14	00	00.00	6	2.69	29	96.67
School C	10	32.26	7	22.58	7	22.58	3	9.68	4	12.90	31	100.00
Total	**24**	**25.81**	**29**	**31.18**	**16**	**18.20**	**5**	**5.38**	**19**	**20.43**	**93**	**98.94**
Use of presentation tools(e.g. PowerPoint)												
School A	9	27.27	4	12.12	6	18.18	2	6.06	12	36.36	33	100.00
School B	3	10.34	12	41.38	4	13.79	3	10.34	7	24.14	29	96.67
School C	4	12.90	9	29.03	8	25.81	5	16.13	5	16.13	31	100.00
Total	**16**	**18.20**	**25**	**26.88**	**18**	**19.35**	**10**	**10.75**	**24**	**25.81**	**93**	**98.94**
Use of teaching courseware (e.g. e-books)												
School A	10	30.30	3	9.09	2	6.06	1	3.03	17	51.52	33	100.00
School B	2	6.67	11	36.67	5	16.67	1	3.33	11	36.67	30	100.00
School C	3	9.68	4	12.90	3	9.68	4	12.90	17	54.84	31	100.00
Total	**15**	**15.96**	**18**	**19.15**	**10**	**10.64**	**6**	**6.38**	**45**	**48.67**	**94**	**100.00**
Use of graphical visualisation tools (e.g. Keylines)												
School A	6	18.18	3	9.09	00	00.00	2	6.06	22	66.67	33	100.00
School B	1	3.33	6	20.00	6	20.00	4	13.33	13	43.33	30	100.00
School C	0	00.00	5	16.13	3	9.68	4	12.90	19	61.29	31	100.00
Total	**7**	**7.45**	**14**	**14.89**	**9**	**9.57**	**10**	**10.64**	**54**	**57.45**	**94**	**100.00**
Use of multimedia (e.g. Windows media player)												
School A	4	12.12	4	12.12	1	3.03	00	00.00	24	72.73	33	100.00
School B	1	3.33	5	16.67	1	3.33	4	13.33	19	63.33	30	100.00
School C	0	00.00	5	16.13	0	00.00	2	6.45	24	77.42	31	100.00
Total	**5**	**5.32**	**14**	**14.89**	**2**	**2.13**	**6**	**6.38**	**67**	**71.28**	**94**	**100.00**

Use of simulation programmes (e.g. learners creating an electric on circuit online programme)												
School A	2	6.06	1	3.03	1	3.03	00	00.00	29	87.88	33	100.00
School B	1	3.33	3	10.00	4	13.33	2	6.67	20	66.67	30	100.00
School C	0	00.00	3	9.68	0	00.00	1	3.23	27	87.10	31	100.00
Total	**3**	**3.19**	**7**	**7.45**	**5**	**5.32**	**3**	**3.19**	**76**	**80.85**	**94**	**100.00**

Respondents who revealed that they used spreadsheets (excel) all the time were two 2.13 per cent (N=2) of the total sample. School B had a larger percentage, that is, 3.33 per cent (N=1), than School A, which had 3.03 per cent (N=1). No respondent used spreadsheets all the time at School C. Respondents who indicated that they often used spreadsheets were 15.96 per cent (N=15) of the total sample. Most of such respondents were from School B, 30.30 per cent (N=9), followed by School A, which had 12.12 per cent (N=4), and then School C, 6.45 per cent (N=2). Respondents who confirmed that they sometimes used spreadsheets were 9.57 per cent (N=9) of the total sample. Most of them were School B respondents, 16.67 per cent (N=5), then School C had 9.68 per cent (N=3) and lastly School A, 3.03 per cent (N=1). Respondents who seldom used spreadsheets were 42.55 per cent (N=40) of the total sample. The largest percentage was from School C respondents, that is, 48.39 per cent (N=15), followed by School A, 45.45 per cent (N=15), and then School B, 33.33 per cent (N=10). A total of 29.79 per cent (N=28) respondents never used spreadsheets. Most of them were School A respondents, 36.36 per cent (N=12), then School C had 35.48 per cent (N=11) and lastly School B, with the fewest respondents, 16.67 per cent (N=5). It can be said that a few respondents used spreadsheets all the time and most of them never used the application. School C respondents had the least spreadsheets skills.

Respondents who indicated that they used the internet all the time were 25.81 per cent (N=24) of the total sample. School C had the largest percentage of respondents who used the internet all the time, that is, 32.26 per cent (N=10). School A had 27.27 per cent (N=9), and School B had the smallest percentage, that is, 17.24 per cent (N=5) respondents who used the internet all the time.

Respondents who often used the internet were 31.18 per cent (N=29). Most of these were School B respondents, 37.93 per cent (N=11), followed by School A which had 33.33 per cent (N=11), and then School C, 22.58 per cent (N=7). Some respondents sometimes used the internet. These were 18.20 per cent (N=16) of the total sample. School B had the largest percentage, that is, 24.14 per cent (N=7), then School C, 22.58 per cent (N=7), and lastly School A, 6.06 per cent (N=2) such respondents. Respondents who seldom used the internet were 5.38 per cent (N=5) of the total sample. School C had the largest percentage, that is, 9.68 per cent (N=3), and School A had 6.06 per cent (N=2). There was no respondent who seldom used the internet at School B. A group of 20.43 per cent (N=19) respondents never used the internet. Most of them were School A respondents, 27.27 per cent (N=9). School B had 20.00 per cent (N=6), and School C had the least respondents, that is, 12.90 per cent (N=4). It can, therefore, be concluded that most respondents used the internet.

Respondents who confirmed that they used the presentation tools (PowerPoint) all the time were 18.20 per cent (N=16) of the total sample. Most of these were School A respondents, that is, 27.27 per cent (N=9). School C had 12.90 per cent (N=4), and School B had the smallest percentage, that is, 10.34 per cent (N=3). Respondents who often used presentation tools were 26.88 per cent (N=25). School B had the largest percentage, that is, 41.38 per cent (N=12), followed by School C, 29.03 per cent (N=9), and then School A, 12.12 per cent (N=4). Those who sometimes used the application were 19.35 per cent (N=18) of the total sample. The largest percentage were School C respondents, 25.81 per cent (N=8), then School A, 18.18 per cent (N=6) and the fewest were from School B, 13.79 per cent (N=4) respondents. Some respondents seldom used presentation tools, and there were 10.75 per cent (N=10) such respondents. School C had the largest percentage, that is, 16.13 per cent (N=5), followed by School B, 10.34 per cent (N=3), and then School A, 6.06 per cent (N=2). A total of 25.81 per cent (N=24) respondents indicated that they never used presentation tools. Most of them were School A respondents, that is, 36.36 per cent (N=12), then School B which had 24.14 per cent (N=7), and lastly School C, 16.13 per cent (N=5). It can, thus, be concluded that most respondents used presentation tools to some extent. There were, however, some who never used the application in teaching.

On the issue of using teaching courseware such as e-books, only 15.96 per cent (N=15) respondents of the total sample confirmed that they used the application all the time in teaching and learning. The largest percentage was from School A respondents, that is, 30.30 per cent (N=10). School C had 9.68 per cent (N=3) and School B, had 6.67 per cent (N=2) such teachers. Respondents who indicated that they often used teaching courseware were 19.15 per cent (N=18) of the total sample. School B had the largest percentage, that is, 36.67 per cent (N=11), followed by School C, 12.90 per cent (N=4), and lastly School A, 9.09 per cent (N=3) such respondents. Respondents who sometimes used teaching courseware were 10.64 per cent (N=10) of the total sample. At School B they were 16.67 per cent (N=5), which constituted the largest percentage, then School C had 9.68 per cent (N=3), and lastly School A had 6.06 per cent (N=2) respondents who sometimes used teaching courseware. Those who seldom used teaching courseware were 6.38 per cent (N=6) of the total sample. The largest percentage was at School C, which had 12.90 per cent (N=4), followed by School B, 3.33 per cent (N=1), and then School A, 3.03 per cent (N=1). Slightly below half of the total number of respondents never used the teaching courseware, that is, 48.67 per cent (N=45). School C had the largest percentage, that is, 54.84 per cent (N=17), then School A, 51.52 per cent (N=17), and lastly School B which had 36.67 per cent (N=11) respondents who never used the teaching courseware. A few respondents used that application all the time.

Another application that respondents were tasked to respond on was the use of graphical visualisation tools. Only 7.45 per cent (N=7) respondents of the total sample used the application all the time in their teaching. School A had the largest percentage, 18.18 per cent (N=6), then School B, 3.33 per cent (N=1), and no one used the application all the time at School C. Respondents who often used the application were 14.89 per cent (N=14) of the total sample. Most of them were School B respondents, that is, 20.00 per cent (N=6), School C had 16.13 per cent (N=5), and School A had the fewest, that is, 9.09 per cent (N=3). A total of 9.57

per cent (N=9) respondents sometimes used the graphical visualisation tools in teaching. The largest percentage of such respondents used the application at School B, that is, 20.00 per cent (N=6), and School C had 9.68 per cent (N=3) such respondents. No respondent sometimes used the application at School A. Those who seldom used the application were 10.64 per cent (N=10) of the total sample. Most of them were School B respondents, 13.33 per cent (N=4), followed by School C, 12.90 per cent (N=4) and then School A, 6.06 per cent (N=2). Most respondents indicated that they never used the graphical visualisation tools in teaching, that is, 57. 45 per cent (N=54). The majority of these respondents were School A respondents, 66.67 per cent (N=22), then School C, 61.29 per cent (N=19), and lastly School B with the fewest, that is, 43.33 per cent (N=13). Thus, a few respondents who used the application in teaching.

Only 5.32 per cent (N=5) respondents of the total sample used multimedia/hypermedia all the time in teaching. School A had a larger percentage, 12.12 per cent (N=4) than School B, which had 3.33 per cent (N=1) such respondents. No one used the application all the time at School C. Respondents who often used the application were 14.89 per cent (N=14). The largest percentage was at School B, 16.67 per cent (N=5), then School C which had 16.13 per cent (N=5), and lastly School A, 12.12 per cent (N=4). Those who sometimes used multimedia/hypermedia were 2.13 per cent (N=2) of the total sample. School B had 3.33 per cent (N=1) and School A, 3.03 per cent (N=1) of such respondents. No respondent sometimes used the application at School C. A total of 6.38 per cent (N=6) respondents seldom used the application. School B had a larger percentage at 13.33 per cent (N=4) than School C, which had 6.45 per cent (N=2). No respondent seldom used the application at School A. The majority of the total sample, 72.28 per cent (N=67) responded that they never used the application in teaching. Most of these respondents were at School C, 77.42 per cent (N=24), followed by School A, 72.73 per cent (N=24), and then School B, 63.33 per cent (N=19).

Furthermore, only 3.19 per cent (N=3) respondents of the total sample indicated that they used simulations all the time in teaching. School A had a larger percentage, 6.06 per cent (N=2) than School B, which had 3.33 per cent (N=1) such respondents. School C did not have any respondent who used the application all the time. Those who often used the application were 7.45 per cent (N=7). School B had the largest percentage, that is, 10.00 per cent (N=3), followed by School C, 9.68 per cent (N=3), and then School A which had 3.03 per cent (N=1). Respondents who sometimes used the simulation programme were 5.32 per cent (N=5) of the total sample. School B had a larger percentage, 13.33 per cent (N=4), than School A, which had 3.03 per cent (N=1) such respondents. Lastly, at School C, no respondent sometimes used the simulation programme. Only 3.19 per cent (N=3) respondents of the total sample seldom used the application. School B had 6.67 per cent (N=2), School C 3.23 per cent (N=1) such respondents, and School A had none. Respondents who responded by confirming that they never used simulation programmes in teaching and learning were 80.85 per cent (N=76). School A had the largest percentage of such respondents, 87.88 per cent (N=29), followed by School C, 87.10 per cent (N=27), and School B which had the smallest percentage, that is, 66.67 per cent (N=20).

Table 8. 16: Mean scores for the use of computer applications in teaching

Computer applications	**School A N=33**		**School B N=30**		**School C N=31**		**Total N=94**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Use of the spreadsheets	2.00	1.09	2.70	1.18	1.87	0.85	2.18	1.10
Use of internet browsing	3.27	1.61	3.31	1.37	3.52	1.39	3.37	1.45
Use of presentation tools	2.88	1.67	3.03	1.40	3.06	1.29	2.99	1.46
Use of teaching courseware	2.64	1.83	2.73	1.46	2.10	1.45	2.49	1.61
Use of graphical visualisation tools	2.06	1.66	2.27	1.31	1.81	1.17	2.04	1.40
Use of multimedia/ hypermedia	1.91	1.55	1.83	1.29	1.55	1.12	1.77	1.33
Use of simulation programmes	1.39	1.12	1.77	1.22	1.42	1.12	1.52	1.152

It can be deduced, from Table 8.16, that overall, there was a low usage of computer applications in teaching as indicated by the total mean scores of all items. Two items had very low mean scores ranging from 1.52 to 1.77 (use of simulation programmes and use of multimedia/ hypermedia), indicating that most teachers almost never used the applications in teaching. Four items (use of graphical visualisation tools, use of teaching courseware, use of presentation tools and use of the spreadsheets) had total mean scores which ranged from 2.04 to 2.99, indicating a low use of applications. It was only one item (use of internet browsing) which had a mean score of 3.37 (sd=1.45), signifying a moderate use of the application.
A total mean score of 2.18 (sd=1.10) indicates that teachers seldom used spreadsheets in teaching. School B had a low mean score of 2.70 (sd=1.18), which was, albeit, below the scale midpoint. School C had the lowest mean score of 1.87 (sd=0.85), indicating that teachers at this school almost never used the application.

Internet browsing was an application that was used moderately by all teachers, as indicated by a total mean score of 3.37 (sd=1.45). All the three schools had mean scores above midpoint 3 but below 4, indicating that teachers at the three schools sometimes used internet browsing in teaching. There was a relatively low use of Presentation tools among teachers, as indicated by a total mean score of 2.99 (sd=1.46). School C had the highest mean score of 3.06 (sd=1.29), indicating a moderate use of the application. School A had the lowest mean score of 2.88 (sd=1.67), indicating that teachers seldom used the application in the classroom.

The use of teaching courseware had a total mean score of 2.49 (sd=1.61), indicating that teachers seldomly used the application. All the three schools had mean score below midpoint 3 but above 2, indicating a low usage of the application. Graphical visualisation tools were also seldom used by all teachers, as indicated by a total low mean score of 2.04 (sd=1.40). School B had a mean score of 2.27 (sd=1.31), indicating a low use of the application, and School C recorded a very low mean score of 1.18 (sd=1.17), indicating that most teachers never used the application.

Most teachers almost never used multimedia in teaching, as indicated by a total low mean score of 1.77 (sd=1.33). All schools had mean scores below 2 but above 1, which indicated a very low use of multimedia in teaching at all the three schools. Another application that was almost never used by most teachers was simulation games, as indicated by a low mean score of 1.52 (sd=1.15). School B had the highest mean score of 1.77 (sd=1.22), which indicated a very low usage of simulation games in teaching. School A had the lowest mean score of 1.39 (sd=1.12), also indicating a very low usage of simulation programmes in teaching.

8.10 Integration of ICTs in teaching

As discussed in section 8.9, Question B3 deals with the extent to which teachers integrate various ICT software in their teaching. A principal factor analysis with varimax rotation was conducted. Only factor loadings of 0.4 or above were taken into account. Two factors were extracted as indicated in Table 8.17. The first factor – Basic ICT Integration – explained 56.407% of the variance and the second factor – Advanced ICT Integration – 15.591% of the variance. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was a satisfactory 0.795, indicating that a problem with multi-collinearity was unlikely.

Table 8. 17: Results of factor analysis for integration of ICTs in teaching

	Factor 1	Factor 2
B3.1 Computer applications - Use of the spreadsheets	.732	
B3.2 Computer applications - Use of internet browsing	.631	
B3.3 Computer applications - Use of presentation tools	.894	
B3.4 Computer applications - Use of teaching courseware	.834	
B3.5 Computer applications - Use of graphical visualisation tools	.683	.556
B3.6 Computer applications - Use of multimedia/ hypermedia		.862
B3.7 Computer applications - Use of simulation programmes		.890

Composite measure for the two factors was consequently calculated. Item B3.5 was categorised with the first factor, as it had the highest loading on this factor. The measure Basic ICT Integration has a satisfactory Cronbach alpha of .864. Scores could vary between 25 and 5, with higher scores being indicative of a higher level of integration. The Cronbach alpha for the second factor – Advanced ICT Integration – was also a satisfactory, namely .782. Scores could vary between 10 and 5, with higher scores indicating higher levels of integration.

Table 8. 18: Mean scores for composite scale for Basic ICT Integration

School	Mean	N	Std. Deviation
A	12.85	33	6.596
B	14.21	28	5.459
C	12.35	31	4.848
Total	13.10	92	5.700

The mean scores and standard deviations are provided in Table 8.18. The conclusion can be drawn that the levels of ICT of teachers of School A and School C were only slightly above or below the scale midpoint, indicating rather mediocre ICT integration. Although the mean for School B is slightly higher, a univariate analysis of variance (ANOVA) indicated no statistical significant differences between the three schools. The results of a follow-up univariate analysis of variance (ANOVA) to test for potential differences for demographic variables indicated the existence of significant differences ($F(26,89)=2.654$; $p=.001$; eta=.523). Age was the only variable which was significant on the .05-level ($p=.034$). Post-hoc Scheffe tests revealed two homogenous subgroups. The mean scores of teachers of 46 years and older (in the first subgroup) were significantly lower than teachers in the two younger subgroups (24 to 35 years and 36 to 45 years).

Table 8.19: Mean scores for composite scale: Advanced ICT Integration

School	Mean	N	Std. Deviation
A	3.30	33	2.338
B	3.60	30	2.298
C	2.97	31	2.152
Total	3.29	94	2.256

The mean scores reported in Table 8.19 indicate that the scores for all three schools were below the scale midpoint of 5, indicating relatively low levels of ICT integration on an advanced level. A univariate analysis of variance (ANOVA) indicated no statistical significant differences between the three schools ($F(2, 93)=.595$; $p=.554$; eta=.013). A follow-up univariate analysis to investigate differences for demographic variables was conducted ($F(26, 91)=1.544$;$p=.081$; eta=.382). Although the overall model does not indicate significant differences, the p-value for educational qualifications was significant on the 0.05-level ($p=.040$). Post-hoc Scheffe tests, however, indicated only one homogeneous subgroup, while none of the comparisons between the different qualification levels (postmatric diploma; bachelor's degree; postgraduate qualification) were significant. The tendency is, nevertheless, that teachers with a higher educational qualification tended to practise advanced levels of integration more than those with lower qualifications.

8.11 Different practices engaged in when teaching using ICTs

The second sub-research objective of this study sought to investigate teacher readiness to use technologies in the classroom. The ability to engage in different practices when teaching using ICTs could be an indication of the ICTs skills that teachers have. Having adequate skills might mean that they are ready to use the technologies. Table 8.20 represents data on how often respondents engaged different practices when teaching using ICTs.

Table 8. 20: Practices engaged in when teaching using ICTs

Statement	Always		Often		Sometimes		To a lesser extent		Not at all		Total	
	5		4		3		2		1			
	N	%	N	%	N	%	N	%	N	%	N	%
When I teach, I use methods which encourage learners to create knowledge through ICTs												
School A	3	9.09	9	27.27	4	12.12	1	3.03	16	48.48	33	100.00
School B	6	20.00	8	26.27	5	16.67	1	3.33	10	33.33	30	100.00
School C	1	3.23	11	35.48	4	12.90	0	00.00	15	48.39	31	100.00
Total	**10**	**10.64**	**28**	**29.79**	**13**	**13.83**	**2**	**2.13**	**41**	**43.62**	**94**	**100.00**
I use ICTs to engage learners with work that requires investigation of complex questions over a long period of time												
School A	2	6.06	10	30.30	3	9.06	0	00.00	18	54.55	33	100.00
School B	3	10.00	10	33.33	8	26.67	1	3.33	8	26.67	30	100.00
School C	2	6.45	5	16.13	12	38.71	1	3.23	11	35.48	31	100.00
Total	**7**	**7.45**	**25**	**26.60**	**23**	**24.47**	**2**	**2.13**	**37**	**39.36**	**94**	**100.00**
I use learner-centred methods when teaching with ICTs												
School A	4	12.12	9	27.27	3	9.09	1	3.03	16	48.48	33	100.00
School B	10	33.33	9	30.00	0	00.00	2	6.67	9	30.00	30	100.00
School C	5	16.33	9	29.03	6	19.35	0	00.00	11	35.48	31	100.00
Total	**19**	**20.21**	**27**	**28.72**	**9**	**9.57**	**3**	**3.19**	**36**	**38.30**	**94**	**100.00**
I adapt my teaching methods to suit different learners when teaching using ICTs												
School A	3	9.09	11	33.33	2	6.06	0	00.00	17	51.52	33	100.00

School B	8	26.67	10	33.33	2	6.67	1	3.33	9	30.30	30	100.00
School C	4	12.90	12	38.71	3	9.68	1	3.23	11	35.48	31	100.00
Total	**15**	**15.96**	**33**	**35.11**	**7**	**7.45**	**2**	**2.13**	**37**	**39.36**	**94**	**100.00**
I select ICTs which best suit the content that I will be teaching												
School A	5	15.15	8	24.24	2	6.06	1	3.03	17	51.52	33	100.00
School B	9	30.00	6	20.00	6	20.00	0	00.00	9	30.00	30	100.00
School C	2	6.45	8	25.81	2	6.45	7	22.58	12	38.71	31	100.00
Total	**16**	**17.02**	**22**	**23.40**	**10**	**10.64**	**8**	**8.51**	**38**	**40.43**	**94**	**100.00**
I assess my learners on an e-learning platform												
School A	0	00.00	1	3.03	2	6.06	2	6.06	28	84.85	33	100.00
School B	2	6.67	5	16.67	1	3.33	1	3.33	21	70.00	30	100.00
School C	0	00.00	0	00.00	2	6.45	3	9.68	26	83.87	31	100.00
Total	**2**	**2.13**	**6**	**6.38**	**5**	**5.32**	**6**	**6.38**	**75**	**79.79**	**94**	**100.00**
I track my learners' progress on the e-learning platform												
School A	1	3.03	2	6.06	1	3.03	2	6.06	27	81.82	33	100.00
School B	2	6.67	3	10.00	2	6.67	0	00.00	23	76.67	30	100.00
School C	0	00.00	2	6.45	0	00.00	2	6.45	27	87.10	31	100.00
Total	**3**	**3.19**	**7**	**7.45**	**3**	**3.19**	**4**	**4.26**	**77**	**81.91**	**94**	**100.00**
I use ICTs in my lessons to facilitate higher order thinking skills, including problem solving and decision making												
School A	2	6.06	12	36.36	3	9.06	0	00.00	16	48.48	33	100.00
School B	5	16.67	6	20.00	5	16.67	2	6.67	12	40.00	30	100.00
School C	0	00.00	10	32.26	4	12.90	2	6.45	15	48.39	31	100.00
Total	**7**	**7.45**	**28**	**29.79**	**12**	**12.77**	**4**	**4.26**	**43**	**45.74**	**94**	**100.00**
I use ICTs in teaching and learning without anyone's help												
School A	4	12.12	11	33.33	2	6.06	0	00.00	16	48.48	33	100.00
School B	5	16.67	8	26.67	6	20.00	2	6.67	9	30.00	30	100.00
School C	2	6.45	8	25.81	3	9.68	3	9.68	15	48.39	31	100.00
Total	**11**	**11.70**	**27**	**28.72**	**11**	**11.70**	**5**	**5.32**	**40**	**42.55**	**94**	**100.00**

It can be deduced, from data in Table 8.20, that 10.64 per cent (N=10) respondents of the total sample always taught using methods which encouraged learners to create knowledge using ICTs. School B had the largest percentage of such respondents, that is, 20.00 per cent (N=6), followed by School A, 9.09 per cent (N=3), and lastly School C, 3.23 per cent (N=1). Respondents who often used such methodologies were 29.79 per cent (N=28) of the total sample. School C had the largest percentage, that is, 35.48 per cent (N=11), School A had 27.27 per cent (N=9), and School B had the smallest percentage, 26.27 per cent (N=8) of such respondents. Those who sometimes used methods which encouraged learners to create knowledge using ICTs were 13.83 per cent (N=13) of the total sample. Most of them were School B respondents, 16.67 per cent (N=5), then School C, 12.90 per cent (N=4), and lastly School A, 12.12 per cent (N=4). Respondents who encouraged learners to create knowledge to a lesser extent were 2.13 per cent (N=2) of the total sample. At School B they were 3.33 per cent (N=1), School A, 3.03 per cent (N=1) such respondents. At School C no respondent practised such methods to a lesser extent. A total of 43.62 per cent (N=41) respondents indicated that they never used methods which encouraged learners to create knowledge using ICTs. Most of them were School A respondents, that is, 48.48 per cent (N=16), then School C with 48.39 per cent (N=15), and lastly School B with 33.33 per cent (N=10). It can, thus, be deduced that some respondents were practising methods which included the use of ICTs in teaching. On the other hand, there were some respondents who did not.

Respondents who indicated that they always used ICTs to engage learners with complex questions were 7.45 per cent (N=7). School B had the largest percentage, that is, 10.00 per cent (N=3), followed by School A, 6.06 per cent (N=2), and then School B, 6.45 per cent (N=2). Respondents who often used ICTs to involve learners with activities which required investigation of complex questions were 26.60 per cent (N=25) of the total sample. The largest percentage were School B respondents, 33.33 per cent (N=10), then School A, 30.30 per cent (N=10), and School C, 16.13 per cent (N=5). Those respondents who sometimes used ICTs to encourage learners to investigate complex questions were 24.47 per cent (N=23) of the total sample. School C respondents constituted the largest percentage, that is, 38.71 per cent (N=12), followed by School B, 26.27 per cent (N=8), and then School A, 9.06 per cent (N=3). Respondents who used ICTs to engage learners with complex questions to a lesser extent were 2.13 per cent (N=2) of the total sample. School B had a larger percentage, 3.33 per cent (N=1), than School C which had 3.23 per cent (N=1) such respondents. At School A, no-one used ICTs to engage learners with complex questions to a lesser extent. Respondents who indicated that they never used ICTs to engage learners with complex questions were 39.36 per cent (N=37) of the total sample. The largest percentage was from School A respondents, that is, 54.55 per cent (N=18), then School C, 35.48 per cent (N=11), and lastly School B, 26.67 per cent (N=8). This indicates a limited use of ICTs in the classroom.

It can further be deduced from the same table that a total of 20.21 per cent (N=19) respondents always used learner-centred methods when teaching with ICTs. Most of them were School B respondents, that is, 33.33 per cent (N=10), then School C, 16.33 per cent (N=5), and lastly School A, 12.12 per cent (N=4). Respondents who indicated that they often used learner-centred methods were 28.72 per cent (N=27) of the total sample. School B had the largest percentage, that is, 30.00 per cent (N=9), followed by School C, 29.03 per cent (N=9), and then School A, 27.27 per cent (N=9). Respondents who sometimes used learner-centred methods when teaching using ICTs were 9.57 per cent (N=9) of the total sample. School C had a larger percentage, 19.35 per cent (N=6), than School A, which had 9.09 per cent (N=3) of such respondents. No respondent sometimes used learner-centred methods at School B. Only 3.19 per cent (N=3) respondents used learner-centred methods to a lesser extent when using ICTs. School B had a larger percentage, 6.67 per cent (N=2), than School A, which had 3.03 per cent (N=1) such respondents. School C did not have respondents who used learner-centred methods to a lesser extent. 38.30 per cent of the respondents (N=36) did not at all use learner-centred methods when teaching using ICTs. Most of them were School A respondents, that is, 48.48 per cent (N=16). School C had 35.48 per cent (N=11), and School B trailed with, 30.00 per cent (N=9).

Furthermore, 15.96 per cent (N=15) respondents of the total sample agreed that they always adapted their teaching to suit different learners when teaching using ICTs. Most of them were School B respondents, 26.67 per cent (N=8), then School C had 12.90 per cent (N=4), and lastly School A with 9.09 per cent (N=3). Respondents who often adapted their teaching to suit different learners were 35.11 per cent (N=33) of the total sample. School C had the largest percentage, that is, 38.71 per cent (N=12), followed by School A, 33.33 per cent (N=11), and then School B with fewest, 33.33 per cent (N=10). Those who sometimes used such methods were 7.45 per cent (N=7) of the total sample. Again, School C had the largest percentage, that is, 9.68 per cent (N=3), then School B, 6.67 per cent (N=2), and lastly School A, 6.06 per cent (N=2). Respondents who sometimes used teaching methods which suited different learners were 2.13 per cent (N=2) of the total sample. School B had 3.33 per cent (N=1), and School C, 3.23 per cent (N=1). School A did not have any respondent who sometimes used such methods. It was also revealed that 39.36 per cent (N=37) of the total sample did not at all adapt their teaching methods to suit different learners when teaching using ICTs. School A had the largest percentage, 51.52 per cent (N=17), followed by School C 35.49 per cent (N=11), and then School B, 30.30 per cent (N=9). It can, thus, be concluded that some respondents had the necessary skills to cater for learners' different learning styles.

It can be deduced, from data in the same table, that 17.02 per cent (N=16) respondents of the total sample had the ability to select ICTs which suited the content that they would be teaching. The largest percentage was from School B respondents, 30.00 per cent (N=9), followed by School A, 15.15 per cent (N=5), and then School C had the fewest, 6.45 per cent (N=2) such respondents. Those who often selected suitable ICTs were 23.40 per cent (N=22) of the total sample. School C had the largest percentage, 25.81 per cent (N=8), then School A, 24.24 per cent (N=8) and lastly School B, 20.00 per cent (N=6). A total of 10.64 per cent (N=10) respondents agreed that they sometimes managed to select suitable ICTs. Most of them were School B respondents, 20.00 per cent (N=6), then School C, 6.45 per cent (N=2), and lastly School A, 6.06 per cent (N=2). Respondents who were able to select suitable ICTs to a lesser extent were 8.51

per cent (N=8) of the total sample. School C had a larger percentage, that is, 22.58 per cent (N=7), than School B, which had 3.03 per cent (N=1). School B had no respondent who was able to select suitable ICTs to a lesser extent. A group of respondents, 40.43 per cent (N=38), indicated that they were unable to select ICTs which suited the content that they taught. The majority of them were School A respondents, 51.52 per cent (N=17), then School C, 38.71 per cent (N=12), and lastly School B, 30.00 per cent (N=9). It can, therefore, be concluded that School B respondents seemed to have the ability to select suitable ICTs to a larger extent, compared to the rest of the schools.

Only 2.13 per cent (N=2) respondents of the total sample indicated that they always assessed learners on an e-learning platform. These were only School B respondents, 6.67 per cent (N=2). Those who often assessed their learners on an e-learning platform were 6.38 per cent (N=6) respondents of the total sample. School B had a larger percentage, 16.67 per cent (N=5), than School A, which had 3.03 per cent (N=1). There were no such respondents at School C. Respondents who sometimes assess learners on e-learning platforms were 5.32 per cent (N=5) of the total sample. School C had the largest percentage, 6.45 per cent (N=2), followed by School A, 6.06 per cent (N=2), and then School B, 3.33 per cent (N=1). Respondents who used e-learning platforms to a lesser extent to assess learners were 6.38 per cent (N=6) of the total sample. Again, School C had the largest percentage, that is, 9.68 per cent (N=3), then School A, 6.06 per cent (N=2), and lastly School B had the fewest, 3.33 per cent (N=1) such respondents. The majority of the respondents, 79.79 per cent (N=75) were unable to assess learners on an e-learning platform. Most of them were School A respondents, 84.85 per cent (N=28), followed by School C, 83.87 per cent (N=26), and then School B, 70.00 per cent (N=21).

The results from Table 8.20 also revealed that 3.19 per cent (N=3) respondents of the total sample had the ability to track learners' progress on an e-learning platform. School B had a larger percentage, 6.67 per cent (N=2), than School A which had 3.03 per cent (N=1) such respondents. Not even a single respondent always tracked learners on e-learning platforms at School C. Respondents who often tracked their learners were 7.45 per cent (N=7) of the total sample. School B had the largest percentage, that is, 10.00 per cent (N=3), then School C, 6.45 per cent (N=2), and lastly School A had the fewest, 6.06 per cent (N=2) such respondents. Those who sometimes tracked their learners on an e-learning platform were 3.19 per cent (N=3) of the total sample. At School B, they were 6.67 per cent (N=2) and at School A, 3.03 per cent (N=1) such respondents. Respondents who tracked their learners to a lesser extent were 4.24 per cent (N=4) of the total sample. School C had 6.45 per cent (N=2) and School A, 6.06 per cent (N=2) such respondents. The majority of respondents, 81.91 per cent (N=77) was unable to track their learners' progress on an e-learning platform. Most of them were School C respondents, 87.10 per cent (N=27), followed by School A, 81.82 per cent (N=27), and then School B, 76.67 per cent (N=23). It can be said that most respondents at the three schools lacked advanced ICT skills, hence could not track learners on an e-learning platform.

Respondents who always used ICTs to facilitate higher order thinking skills, including decision-making and problem-solving, were 7.45 per cent (N=7) of the total sample. School B had 16.67 per cent (N=5) and School A, 6.06 per cent (N=2) such respondents. There were no such respondents at School C. Respondents who often used ICTs to facilitate higher order thinking skills were 29.79 per cent (N=28) of the total sample. Most of them were School A respondents, 36.36 per cent (N=12), followed by School C, 32.26 per cent (N=10), and lastly School B, 20.00 per cent (N=6). Those who sometimes used the technology to enhance the development of complex thinking skills were 12.77 per cent (N=12) of the total sample. The largest percentage was from School B respondents, 16.67 per cent, followed by School C, 12.90 per cent (N=4), and lastly School A had the fewest, 9.06 per cent (N=3). There were 4.26 per cent (N=4) of the total sample who used ICTs to a less extent in lessons to facilitate higher order thinking skills. School B had a larger percentage, that is, 6.67 per cent (N=2) than School C, which had 6.45 per cent (N=2) such respondents. No one at School A used ICTs to a less extent in lessons to facilitate higher order thinking skills. A group of 45.74 per cent (N=43) respondents agreed that they did not use ICTs to facilitate higher order thinking skills among learners at all. School

A had 48.48 per cent (N=16), constituting the largest percentage of the respondents, followed by School C, with 48.39 per cent (N=15) and School B, 40.00 per cent (N=12). Hence, it can be said that the respondents' use of ICTs to facilitate higher order thinking skills among learners was limited.

Respondents who always used ICTs in teaching without anyone's assistance were 11.70 per cent (N=11) of the total sample. The largest percentage was from School B respondents, 16.67 per cent (N=5), then School A had 12.12 per cent (N=4) and lastly, School C had 6.45 per cent (N=2) such respondents. Those who often used ICTs without help were 28.72 per cent (N=27) of the total sample. School A had the largest percentage, that is, 33.33 per cent (N=11), followed by School B, 26.67 per cent (N=8), and then School C, 25.81 per cent (N=8). It can also be deduced, from the table, that a total of 11.70 per cent (N=11) respondents sometimes used ICTs without anyone's help. The largest percentage was at School B which had 20.00 per cent (N=6), followed by School C, 9.68 per cent (N=3), and then School A, 6.06 per cent (N=2). Those who could use ICTs in teaching without help to a less extent were 5.32 per cent (N=5) of the total sample. School C had had a larger percentage, 9.68 per cent (N=3), than School B, which had 6.67 per cent (N=2) such respondents. At School A, no respondent used ICTs without help to a lesser extent. A total of 42.55 per cent (N=40) respondents were not at all able to use ICTs in teaching without getting help. Most of them were School A respondents, 48.48 per cent (N=16), followed by School C, with 48.39 per cent (N=15), and lastly School B, which had the fewest, 30.00 per cent (N=9). It can, thus, be concluded that most respondents were unable to use ICTs without help, indicating limited ICT skills.

Table 8. 21: Mean scores for practices engaged in when teaching using ICTs

	School A N=33		**School B N=30**		**School C N=31**		**Total N=94**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
When I teach, I use methods which encourage learners to	2.45	1.54	2.97	1.59	2.45	1.48	2.62	1.54

create knowledge through ICTs								
I use ICTs to engage learners with work that requires investigation of complex questions over a long period of time	2.33	1.53	2.97	1.38	2.55	1.31	2.61	1.42
I use learner-centred methods when teaching with ICTs	2.52	1.60	3.30	1.71	2.90	1.56	2.89	1.64
I adapt my teaching methods to suit different learners when teaching using ICTs	2.48	1.60	3.23	1.63	2.90	1.56	2.86	1.61
I select ICTs which best suit the content that I will be teaching	2.48	1.66	3.20	1.63	2.39	1.41	2.68	1.59
I assess my learners on an e-learning platform	1.27	0.72	1.87	1.43	1.23	0.56	1.45	1.00
I track my learners' progress on the e-learning platform	1.42	1.03	1.70	1.34	1.26	0.77	1.46	1.07
I use ICTs in my lessons to facilitate higher order thinking skills, including problem solving and decision making	2.52	1.54	2.67	1.58	2.29	1.37	2.49	1.49
I use ICTs in teaching and learning without anyone's help	2.61	1.64	2.93	1.51	2.32	1.47	2.62	1.55

The mean scores for all the practices related to using ICTs in teaching were below the scale midpoint of 3, indicating relatively low usage of these practices. School B had a mean score of 2.97 (sd=1.59), indicating a low usage of such methods. Both School A (sd=1.54) and School C (sd=1.48) had the same low mean score of 2.45, indicating that teachers used methods which encouraged learners to create knowledge through ICTs to a lesser extent.

Furthermore, a total mean score of 2.61 (sd=1.42) indicates a relatively low usage of ICTs by teachers to engage learners with work that requires investigation of complex questions over a long period of time. School B had the highest mean score of 2.97 (sd=1.38), which was below midpoint 3, signifying that teachers used ICTs to engage learners with work that requires investigation of complex questions over a long period to a lesser extent. School A had the smallest mean score of 2.33 (sd=1.53), which is another indication of low usage of ICTs by teachers to engage learners with the practice.

A total mean score of 2.89 (sd=1.64) is an indication of low usage of learner-centred methods when teaching with ICTs. School B, however, had a mean score of 3.30 (sd=1.71), indicating that teachers used learner-centred methods when teaching with ICTs to a moderate extent. School A and School C both had low mean scores of 2.52 (sd=1.60) and 2.90 (sd=1.56), respectively, indicating that they used learner-centred methods to a lesser extent when teaching with ICTs.

Teachers adapted their teaching methods to suit different learners when teaching using ICTs to a lesser extent, as indicated by a total low mean score of 2.86 (sd=1.61). Schools A and C both had low mean scores of 2.48 (sd=1.60) and 2.90 (sd=1.56), respectively, indicating a low adaptation of the practice. However, School B had a larger mean score of 3.23 (sd=1.63), indicating that teachers adapted their teaching methods to suit different learners to a moderate extent.

A total low mean score of 2.68 (sd=1.59) indicates that teachers at the three schools selected ICTs which best suit the content that they were teaching, to a lesser extent. The largest mean score was recorded at School B, 3.20 (sd=1.63), indicating that teachers were able to select ICTs which best suit content to a moderate extent. This was followed by School A, 2.48 (sd=1.66), and lastly School C, 2.39 (sd=1.41), indicating that teachers at both schools had the ability to select ICTs which best suit the content that they were teaching to a lesser extent.

A practice that had a very low total mean score of 1.45 (sd=1.00) was assessing of learners on an e-learning platform. All the three schools had very low mean scores, indicating that teachers almost never assessed learners on an e-learning platform.

Tracking learners' progress on an e-learning platform had a very low total mean score of 1.46 (sd=1.07), indicating that a very few teachers tracked learners' progress on the e-learning platform. The three schools recorded very low mean scores, indicating that teachers almost never tracked learners on an e-learning platform.

A total low mean score of 2.49 (sd=1.49) was obtained for teachers who used ICTs in their lessons to facilitate higher order thinking skills, including problem-solving and decision-making, indicating that the majority of teachers practised that to a lesser extent. All the three schools had low mean scores, below the midpoint 3, indicating that teachers used ICTs in their lessons to facilitate higher order thinking skills to a lesser extent.

Furthermore, a total low mean score of 2.62 (sd=1.55) was obtained for teachers who used ICTs in teaching and learning without anyone's help. All the three schools recorded low mean score below the midpoint 3, indicating that teachers could use ICTs in teaching without anyone's help to a lesser extent.

Overall, it can be deduced that seven items out of nine had low mean scores which ranged from 2.49 to 2.89, indicating that these teachers implement ICTs practices in teaching and learning to a lesser extent. Two items out of nine had a very low mean score of 1.45 and 1.46, which indicated that most of these teachers almost never practised teaching methodologies which included ICTs in the classroom.

8.12 ICT training and support needs of respondents

Investigating teacher readiness to use technologies in the classroom was the second sub-research objective of this study. ICT training is one of the factors that affect teacher readiness to use the technologies in teaching and learning. Table 8.22 presents data on ICT training that respondents might have undergone and their support needs.

Table 8. 22: Frequency distributions for ICT training

ICT training and support	Large extent		Some extent		Uncertain		To a small extent		Not at all		Total	
	5		4		3		2		1			
	N	%	N	%	N	%	N	%	N	%	N	%
I have been trained on how to use a variety of ICTs in teaching												
School A	8	24.24	11	33.33	0	00.00	7	21.21	7	21.21	33	100.00
School B	11	36.67	10	33.33	1	3.33	3	10.00	5	16.67	30	100.00
School C	2	6.45	17	54.84	0	00.00	4	12.90	8	25.81	31	100.00
Total	**21**	**22.34**	**38**	**40.43**	**1**	**1.06**	**14**	**14.89**	**20**	**21.28**	**94**	**100.00**
I have been trained which ICTs are appropriate for the subject that I teach												
School A	6	18.18	12	36.36	0	00.00	7	21.21	8	24.24	33	100.00
School B	8	26.67	12	40.00	1	3.33	4	13.33	5	16.67	30	100.00
School C	1	3.23	14	45.16	4	12.90	1	3.23	11	35.48	31	100.00
Total	**15**	**15.96**	**38**	**40.43**	**5**	**5.32**	**12**	**12.77**	**24**	**25.53**	**94**	**100.00**
The ICT training courses which I received integrate teaching methods, subject content and ICTs												
School A	6	18.18	12	36.36	1	3.03	5	15.15	9	27.27	33	100.00
School B	7	23.33	10	33.33	5	16.67	3	10.00	5	16.67	30	100.00
School C	3	9.68	14	45.16	2	6.45	5	16.13	7	22.58	31	100.00
Total	**16**	**17.02**	**36**	**38.30**	**8**	**8.51**	**13**	**13.83**	**21**	**22.34**	**94**	**100.00**
I am confident to use ICTs when I teach												
School A	7	21.21	10	30.30	3	9.09	4	12.12	9	27.27	33	100.00
School B	5	16.67	12	40.00	8	26.67	1	3.33	4	13.33	30	100.00
School C	4	12.90	8	25.81	6	19.35	4	12.90	9	29.03	31	100.00
Total	**16**	**17.02**	**30**	**31.91**	**17**	**18.09**	**9**	**9.57**	**22**	**23.40**	**94**	**100.00**
I select ICTs that enhance the content that I teach												
School A	6	18.18	10	30.30	1	3.03	1	3.03	15	45.45	33	100.00
School B	7	23.33	10	33.33	7	23.33	2	6.67	4	13.33	30	100.00

School C	4	12.90	7	22.58	3	9.68	6	19.35	11	35.48	31	100.00
Total	**17**	**18.09**	**27**	**28.72**	**11**	**11.70**	**9**	**9.57**	**30**	**31.91**	**94**	**100.00**
I use teaching strategies that combine teaching methods, subject content and ICTs												
School A	4	12.12	11	33.33	1	3.03	1	3.03	16	48.48	33	100.00
School B	7	23.33	9	30.00	8	26.67	2	6.67	4	13.33	30	100,00
School C	4	12.90	12	38.71	2	6.45	5	16.13	8	25.81	31	100.00
Total	**15**	**15.96**	**32**	**34.04**	**11**	**11.70**	**8**	**8.51**	**28**	**29.79**	**94**	**100.00**

Respondents who were trained on how to use a variety of ICTs in teaching and learning to a large extent were 22.34 per cent (N=21) of the total sample. School B had the largest percentage of such respondents, that is, 36.67 per cent (N=11), followed by School A, with 24.24 per cent (N=8), and lastly School C which had 6.45 per cent (N=2) such respondents. Respondents who were trained to some extent were 40.43 per cent (N=38) of the total sample. The majority of them were School C respondents, 54.84 per cent (N=17), followed by School A, 33.33 per cent (N=11), and then School B which had the least, 33.33 per cent (N=10) such respondents. Only one respondent at School B, 3.33 per cent, was uncertain of his or her training. This might imply that respondents at School A and School C were certain of their training. The results further revealed that 14.89 per cent (N=14) of the total sample were trained to a small extent. School A had the largest percentage, 21.21 per cent (N=7), followed by School C, 12.90 per cent (N=4), and then School B, 10.00 per cent (N=3) respondents who were trained to a small extent. Respondents who were not trained at all were 21.28 per cent (N=20) of the total sample. The majority of them were School C respondents, 25.81 per cent (N=8), then School A, 21.21 per cent (N=7), and School B, with the smallest percentage, that is, 16.67 per cent (N=5). It can be said that ICT training was limited to some respondents, hence not all respondents could confidently use the technologies in teaching and learning.

It can further be deduced, from Table 8.22, that respondents who were trained to a large extent were 15.96 per cent (N=15) of the total sample. School B had the largest percentage, that is, 26.67 per cent (N=8), followed by School A, 18.18 per cent (N=6), and lastly School C, 3.23 per cent (N=1) of such teachers. It can be deduced that School C respondents did not receive adequate training, compared to the other two schools. Those who were trained to some extent were 40.43 per cent (N=38) of the total sample. School C had the largest percentage, that is, 45.16 per cent (N=14), then School B, 40.00 per cent (N=12), and lastly School A, 36.36 per cent (N=12). Respondents who were uncertain of their training were 5.32 per cent (N=5) of the total sample. The largest percentage was at School C which had 12.90 per cent (N=4), followed by School B, 3.33 per cent (N=1) such respondents. All respondents at School A were certain of their training. Respondents who were trained to a small extent were 12.77 per cent (N=12) of the total sample. The largest percentage was from School A respondents, 21.21 per cent (N=7), followed by School B, 13.33 per cent (N=4) and then School C, 3.23 per cent (N=1). Some respondents agreed that they were not trained at all on which ICTs were appropriate for the subject that they were teaching. These were 25.53 per cent (N=24) of the total respondents. Most of them were School C respondents, 35.48 per cent (N=11), followed by School A, 24.24 per cent (N=8), and School B had the fewest of such respondents, that is, 16.67 per cent (N=5). It can, therefore, be said that not every respondent received training.

Respondents who agreed to a large extent that the ICT training course which they received integrated teaching methodology, subject content and the use of technology were 17.02 per cent (N=16) of the total sample. The majority of them were School B respondents, 23.33 per cent (N=7), followed by School A, 18.18 per cent (N=6), and School C had the smallest percentage, that is, 9.68 per cent (N=3). It can be deduced that a few respondents were equipped with technology, pedagogy and content knowledge. Those who were trained to some extent were 38.30 per cent (N=36) of the total sample. School C had the largest percentage, 45.16 per cent (N=14), followed by School A, 36.36 per cent (N=12), and then School B, 33.33 per cent (N=10). Respondents who were uncertain of their training were 8.51 per cent (N=8) of the total sample. The majority of them were School B respondents, 16.67 per cent (N= 5), followed by School C, 6.45 per cent

(N=2), and lastly School A which had the smallest percentage, 3.03 per cent (N=1). Uncertainty might be an indication of inadequacy in their training. Respondents who were trained to a small extent were 13.83 per cent (N=13) of the total sample. Most of them were School C respondents, 16.13 per cent (N=5), followed by School A which had 15.15 per cent (N=5) then School B with 10.00 per cent (N=3) such respondents. A total of 22.34 per cent (N=21) respondents agreed that they were not trained at all. School A had the largest percentage, 27.27 per cent (N=9), School C 22.58 per cent (N=7), and lastly School B which had the smallest percentage, 16.67 per cent (N=5).

Those who were confident in using ICTs to a large extent when teaching were 17.02 per cent (N=16) of the total sample. School A had the largest percentage, 21.21 per cent (N=7), followed by School B, 16.67 per cent (N=5), and then School C, 12.90 per cent (N=4) such respondents. Respondents who revealed that they were confident to some extent were 31.91 per cent (N=30) of the total sample. School B had the largest percentage, 40.00 per cent (N=12), School A 30.30 per cent (N=10), and School C had the smallest percentage, 25.81 per cent (N=8). The uncertain respondents were 18.09 per cent (N=17) of the total sample. Most uncertain respondents were at School B, that is, 26.27 per cent (N=8), followed by School C, 19.35 per cent (N=6), and then School A, 9.09 per cent (N=3). Those who were confident to a small extent were 9.57 per cent (N=9) of the total sample. Most of them were School C respondents, 29.03 per cent (N=9), then School A, 27.27 per cent (N=9), and lastly School B, 13.33 per cent (N=4). Respondents who were not confident at all were 23.40 per cent (N=22) of the total sample. School C had the largest percentage, 29.03 per cent (N=9), followed School A, 27.27 per cent (N=9), and School B had the smallest percentage, 13.33 per cent (N=4) such respondents. Lack of confidence in using ICTs might be an indication of limited ICT skills.

It can further be deduced, from Table 8.22, that respondents who were to a large extent able to select ICTs that enhanced the content that they were teaching were 18.09 per cent (N=17) of the total sample. School B had the largest percentage, 23.33 per cent (N=7), School A 18.18 per cent (N=6), and School C 12.90 per cent (N=4) such respondents. Those who were able to select ICTs to a small extent were 28.72 per cent (N=27) of the total sample. Most of them were School B respondents, 33.33 per cent (N=10), followed by School A, 30.30 per cent (N=10), and lastly School C, 22.58 per cent (N=7) such respondents. Respondents who were uncertain were 11.70 per cent (N=11) of the total sample. The largest percentage was from School B respondents, 23.33 per cent (N=7), followed by School C, 9.68 per cent (N=3), and School A had the smallest percentage, that is, 3.03 per cent (N=1). Respondents who were able to select ICTs to a small extent were 9.57 per (N=9) of the total sample. School C had the largest percentage, 19.35 per cent (N=6), then School B, 6.67 per cent (N=2), and finally School A, 3.03 per cent (N=1) such respondents. Respondents who did not have the ability to select ICTs were 31.91 per cent (N=30) of the total sample. The majority of them were from School A, 45.45 per cent (N=15), followed by School C, 35.48 per cent (N=11) and last School B, which had the smallest percentage, that is, 13.33 per cent (N=4). It can be said that some respondents were able to select ICTs, which might mean that they had the required skills. Some respondents were not at all able to select ICTs and that might be an indication of a lack of ICT skills.

Those who responded by agreeing to a large extent that they used teaching strategies that combined teaching methodology, subject content and the use of technology were 15.96 per cent (N=15) of the total sample. School B had the largest percentage, 23.33 per cent (N=7), then School C, 12.90 per cent (N=4), and lastly School A which had 12.12 per cent (N=4) of such respondents. Respondents who agreed that they used such strategies to some extent were 34.04 per cent (N=32) of the total sample. School C had the largest percentage, 38.71 per cent (N=12), then School A, 33.33 per cent (N=11), and School B had the smallest percentage, that is, 30.00 per cent (N=9). Respondents who were uncertain were 11.70 per cent (N=11) of the total sample. School B had the largest percentage, 26.67 per cent (N=8), followed by School C with 6.45 per cent (N=2), and lastly School A, with the smallest percentage, 3.03 per cent (N=1). Some 8.51 per cent (N=8) respondents agreed that they used such teaching strategies to a small extent. School C had the largest percentage, 16.13 per cent

(N=5) of such respondents, then School B, 6.67 per cent (N=2), and lastly School A, with the smallest percentage, 3.03 per cent (N=1). Respondents who indicated that they did not at all combine methodology, subject content and technology were 28.72 per cent (N=27) of the total sample. Most of them were School A respondents, 48.48 per cent (N=16), then School C, 25.81 per cent (N=8), and lastly School B, 13.33 per cent (N=4). It can, thus, be concluded that a few respondents had adequate ICT skills and were using them in teaching and learning.

Table 8. 23: Mean scores for training received and teachers' confidence in using ICTs

	School A N=33		**School B N=30**		**School C N=31**		**Total N=94**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
I have been trained on how to use a variety of ICTs in teaching and learning	3.18	1.55	3.63	1.50	3.03	1.43	3.28	1.50
I have been trained which ICTs are appropriate for the subject that I am teaching	3.03	1.53	3.47	1.46	2.77	1.43	3.09	1.49
The ICT training courses which I received integrate teaching methodology, subject content and ICTs	3.03	1.55	3.37	1.402	3.03	1.40	3.14	1.45
I am confident to use ICTs when I teach	3.06	1.56	3.43	1.22	2.81	1.45	3.10	1.43
I select ICTs that enhance the content that I teach	2.73	1.71	3.47	1.31	2.58	1.50	2.91	1.55
I use teaching strategies that combine teaching methodology, subject content and ICTs	2.58	1.64	3.43	1.31	3.10	1.47	3.02	1.51

The majority of the mean scores are marginally above the scale midpoint of 3, indicating rather mediocre levels of training and confidence to use ICTs. In the case of selection of ICTs which enhance the subject contents, the mean is below 3, indicating relatively low levels of confidence to select appropriate technologies and contents. School B seems to have the highest mean scores for all these aspects.

Most teachers were moderately trained on how to use a variety of ICTs in teaching and learning, as evidenced by a total mean score of 3.28 (sd=1.50). School B had the largest mean score of 3.63 (sd=1.50), indicative of low ICTs skills.

A total mean score of 3.09 (sd=1.49) indicates that teachers were moderately trained on which ICTs were appropriate for their teaching subjects. Schools A and B had 3.03 (sd=1.53) and 3.47 (sd=1.46) mean scores, respectively, an indication of moderate training on ICTs which were appropriate for their teaching subjects. On the other hand, School C had a low mean score of 2.77 (sd=1.43), indicating that the teachers were trained to a small extent on ICTs appropriate for their teaching subjects.

Furthermore, the ICT training course that all teachers received moderately integrated teaching methodology, subject content and the use of technology, as indicated by a total mean score of 3.14 (sd=1.45). School B had the largest mean score, 3.37 (sd=1.40) and both Schools A (sd=1.55) and C (sd=1.40) had the same mean score, 3.03, indicating that teachers were moderately trained on how to integrate methodology, subject content and the use of technology.

A total mean score of 3.10 (sd=1.43) indicates that teachers at the three schools were moderately confident to use ICTs when they taught in the classroom. Schools A and B had mean scores of 3.06 (sd=1.56) and 3.43 (sd=1.22), respectively, an indication of moderate confidence when using ICT to teach. School C respondents, on the other were confident when teaching using ICTs to a small extent, as indicated by a mean score of 2.81 (sd=1.45).

It can further be deduced that teachers were to a small extent able to select ICTs that enhanced the content that they taught, as indicated by a total low mean score of 2.91 (S=1.55). Schools A and C had mean scores of 2.73 (sd=1.70) and 2.58 (sd=1.50), respectively, indicating that the teachers were to a small extent able to select ICTs that enhanced the content that they taught. On the other hand, School B had a mean score of 3.47 (sd=1.70), indicating that teachers were to a moderate extent able to select ICTs that enhanced the content that they taught.

Teachers were to a moderate extent able to use teaching strategies that combine teaching methodology, subject content and the use of technology, as indicated by a total mean score of 3.02 (sd=1.51). Schools B and C had mean scores of 3.43 (sd=1.31) and 3.10 (sd=1.47), respectively, indicating that teachers at the two schools were to a moderate extent able to use teaching strategies that combine teaching methodology, subject content and the use of technology. School A teachers were able to do that to a small extent, as indicated by a mean score of 2.58 (sd=1.64).

Overall, five items out of six items had mean scores which ranged from 3.02 to 3.28, indicating that most teachers were moderately trained on how to use ICTs in teaching and learning. Only one item had a total mean score of 2.91, indicating that teachers were to a small extent trained on how to select ICT that enhanced content that they taught.

Table 8. 24: Results of factor analysis of training received and teachers' confidence to use ICTs

	Component
	1
D1.1 I have been trained on how to use a variety of ICTs in teaching and learning	.902
D1.2 I have been trained which ICTs are appropriate for the subject that I am teaching	.901
D1.3 The ICT training courses which I received integrate teaching methodology, subject content and the use of technology	.928
D1.4 I am confident to use ICTs when I teach	.927
D1.5 I select ICTs that enhance the content that I teach	.911
D1.6 I use teaching strategies that combine teaching methodology, subject content and the use of technology without	.841

As discussed, the question in section D deals with the teachers' perceptions of the sufficiency of ICT training that they received and whether they felt confident that they had the necessary skills to integrate ICTs in teaching and learning. A principal factor analysis with varimax rotation was conducted. Only factor loadings of 0.4 or above were taken into account. Only one factor was extracted which explained 81.461% of the variance. All six items loaded on this factor (see Table 8.24). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was a satisfactory 0.890 indicating that a problem with multicollinearity is unlikely.

A composite measure – Training Sufficiency and Confidence to use ICTs – was, consequently, calculated by adding the six items. Scores could vary between 5 and 30. Higher scores were indicative of higher levels of confidence to integrate ICTs in teaching and learning. The mean scores are reported in Table 8.23. All the mean scores were just slightly above the scale midpoint of 15, indicating satisfactory – but not high – levels of confidence to implement ICTs based on the training they received. Although teachers of School B had the highest mean scores, a univariate analysis of variance (ANOVA) indicated no statistical significant differences between the three schools ($F(2,93)=1.791$; $p=.173$; eta=.038). A univariate analysis of variance (ANOVA) was further conducted to investigate differences with regard to gender, age, highest educational qualifications and years of experience. The final model showed no statistical differences with regard to any of these variables ($F(26, 91)=1.474$; $p=.105$; eta=.331).

8.13 Importance of ICT training and support

To further investigate teacher readiness to use technologies in the classroom (sub-research objective two), respondents responded to questions on the importance of ICT training and support. ICT training and support that teachers are afforded impacts on their readiness to use ICTs in the classroom. Table 8.25 presents data on the level of importance that respondents place on ICT training and support.

Table 8. 25: Frequency distributions for perceptions of the Importance of ICT training and support

	Very important		Somewhat important		Neutral		Somewhat unimportant		Unimportant at all		Total	
	5		**4**		**3**		**2**		**1**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Professional development course												
School A	29	87.88	1	3.03	2	6.06	0	00.00	1	3.03	33	100.00
School B	18	60.00	4	13.33	6	20.20	2	6.67	0	00.00	30	100.00
School C	26	83.87	4	12.90	0	00.00	0	00.00	1	3.23	31	100.00
Total	**73**	**78.46**	**9**	**9.57**	**8**	**8.51**	**2**	**2.13**	**2**	**2.13**	**94**	**100.00**
ICT seminars												
School A	29	87.88	2	6.06	2	6.06	0	00.00	0	00.00	33	100.00
School B	18	60.00	5	16.67	5	16.67	2	6.67	0	00.00	30	100.00
School C	25	80.66	4	12.90	0	00.00	0	00.00	2	6.45	31	100.00
Total	**72**	**76.60**	**11**	**11.70**	**7**	**7.45**	**2**	**2.13**	**2**	**2.13**	**94**	**100.00**
ICT support personnel												
School A	30	90.91	1	3.03	2	3.03	0	00.00	0	00.00	33	100.00
School B	19	63.33	5	16.67	4	13.33	2	6.67	0	00.00	30	100.00
School C	23	74.19	6	19.35	0	00.00	0	00.00	2	6.45	31	100.00
Total	**72**	**76.60**	**12**	**12.77**	**6**	**6.38**	**2**	**2.13**	**2**	**2.13**	**94**	**100.00**

It can be deduced, from data in Table 8.25, that the majority of the respondents, 78.46 per cent (N=73) of the total sample, rated that professional development courses were very important. School A had the largest percentage, that is, 87.88 per cent (N=29), followed by School C, 83.87 per cent (N=26) and then School B had the smallest percentage, 60.00 per cent (N=18). Those who responded that professional development courses were somewhat important were 9.57 per cent (N=9). The largest percentage of such respondents were at School B, 13.33 per cent (N=4), followed by School C which had 12.90 per cent (N=4), and then School A, 3.03 per cent (N=1) such respondents. Respondents who were neutral were 8.51 per cent (N=8). School B had a larger percentage, 20.20 per cent (N=6), than School A, which had 6.06 per cent (N=2). School C did not have any respondents who were neutral. Respondents who agreed that professional development courses were somewhat unimportant were 2.13 per cent (N=2) of the total sample. All of them were School B respondents, 6.67 per cent (N=2). Those who indicated that development courses were unimportant at all were also 2.13 per cent (N=2). School C had 3.23 per cent (N=1), and School A 3.03 per cent (N=1) such respondents. Only a few respondents rated ICT training and support needs as unimportant at all.

It can further be deduced, from data in Table 8.25, that the majority of the respondents, 79.60 per cent (N=72) of the total sample, rated ICT seminars very important. School A had the largest percentage, that is, 87.88 per cent (N=29), School C 80.66 per cent (N=25), and School B had 60.00 per cent (N=18) such respondents. Those who regarded ICT seminars somewhat important were 11.70 per cent (N=11) of the total sample. The largest percentage was at School B, 16.67 per cent (N=5), followed by School C, 12.90 per cent (N=4), and then School A which had the smallest percentage, 6.06 per cent (N=2). The neutral respondents were 7.45 per cent (N=7) of the total sample. School B had a larger percentage, 16.67 per cent (N=5), than School A, which had 6.06 per cent (N=2) such respondents. There were no neutral respondents at School C. Some respondents responded that ICT seminars were somewhat unimportant and these were 2.13 per cent (N=2) of the total sample. All of them were School B respondents, 6.67 per cent (N=2). It was only School C respondents, 2.13 per cent (N=2) who rated ICT seminars unimportant at all. Thus, it can be concluded that most of the respondents agreed that ICT seminars were very important.
The majority of the respondents, 76.60 per cent (N=72) of the total sample, rated ICT support personnel as very important. School A had the largest percentage, 90.91 per cent (N=30), followed by School C, 74.19 per cent (N=23) and School B which had the smallest percentage, 63.33 per cent (N=19). Those who responded that ICT support personnel were somewhat important were 12.77 per cent (N=12) of the total sample. School C had the largest percentage, 19.35 per cent (N=6), School B, 16.67 per cent (N=5) and School A had the smallest percentage, 3.03 per cent (N=1) such respondents. The neutral respondents were 6.38 per cent (N=6). School B had a larger percentage, 13.33 per cent (N=4), than School A, which had 6.06 per cent (N=2) such respondents. The

same number of respondents, 2.13 per cent (N=2) of the total sample, rated ICT personnel support at schools as somewhat unimportant and unimportant at all. It was only School B respondents, 6.67 per cent (N=2) who agreed that ICT support personnel were somewhat unimportant. School C, 6.45 per cent (N=2), rated the same personnel as unimportant at all. Only a few respondents regarded ICT personnel as unimportant.

Table 8. 26: Mean scores for perceptions of the importance of ICT training and support

	School A N=33		School B N=30		School C N=31		Total N=94	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Professional development course	4.73	0.84	4.27	1.01	4.74	0.77	4.59	0.90
ICT seminars	4.82	0.53	4.30	0.99	4.61	1.02	4.59	0.89
ICT support personnel	4.85	0.51	4.37	0.96	4.55	1.02	4.60	0.87

All these forms of training were rated as very important. The highest mean score was, however, for support personnel, indicating that this aspect was of the greatest importance to teachers. Support personnel refers to a school based ICT-technician.

ICT support personnel had the largest total mean score, m=4.60 (sd=0.87), indicating that teachers placed a high importance on such support. Professional development courses and ICT seminars had the same total mean score of 4.59, indicating that teachers also placed a high importance on such ICT training and support programmes.

8.14 Challenges in the adoption and use of ICTs in teaching and learning

In order to answer the third sub-research question on factors that influence the integration of ICTs in teaching and learning, teachers were asked challenges that they faced when adopting technologies in the classroom. Table 8:27 thus presents data on the importance that respondents placed on barriers to the adoption and use of ICTs in schools.

Table 8. 27: Frequency distributions for perceptions of barriers to ICTs adoption and use in schools

	Not an important barrier at all		**Less important barrier**		**Important barrier**		**High important barrier**		**Very high important barrier**		**Total**	
	5		**4**		**3**		**2**		**1**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Inadequate training on ICT use in the teaching of my particular subject												
School A	1	3.03	9	27.27	8	24.24	11	33.33	4	12.12	33	100.00
School B	6	20.00	12	40.00	1	3.33	3	10.00	8	26.67	30	100.00
School C	2	6.45	4	12.90	6	19.35	8	25.81	11	35.48	31	100.00
Total	**9**	**9.57**	**25**	**26.60**	**15**	**15.96**	**22**	**23.40**	**23**	**24.47**	**94**	**100.00**
Lack of a school-based technician												
School A	0	00.00	2	6.06	15	45.45	11	33.33	5	15.15	33	100.00
School B	5	16.67	9	30.00	7	23.33	5	16.67	4	13.33	30	100.00
School C	4	2.90	0	00.00	8	25.81	7	22.58	12	38.71	31	100.00
Total	**9**	**9.57**	**11**	**11.70**	**30**	**31.91**	**23**	**24.47**	**21**	**22.34**	**94**	**100.00**
Limited supply of electricity												
School A	0	00.00	3	9.09	1	3.03	22	66.67	7	21.21	33	100.00
School B	3	10.00	1	3.33	10	33.33	7	23.33	9	30.00	30	100.00
School C	1	3.23	2	6.45	1	3.23	2	6.45	25	80.65	31	100.00
Total	**4**	**4.26**	**6**	**6.38**	**12**	**12.77**	**31**	**32.98**	**41**	**43.62**	**94**	**100.00**
Limited access to high speed internet												
School A	0	00.00	0	00.00	3	9.09	21	63.64	9	27.27	33	100.00
School B	2	6.67	2	6.67	6	20.00	8	26.67	12	40.00	30	100.00
School C	1	3.23	3	9.68	2	6.45	4	12.90	21	67.74	31	100.00
Total	**3**	**3.19**	**5**	**5.32**	**11**	**11.70**	**33**	**35.11**	**42**	**44.68**	**94**	**100.00**

Lack of educational software for my particular subject (e.g. games)												
School A	0	00.00	5	15.15	11	33.33	8	24.24	9	27.27	33	100.00
School B	3	10.00	9	30.00	5	16.67	8	26.67	5	16.67	30	100.00
School C	1	3.23	3	9.68	7	22.58	0	00.00	20	64.52	31	100.00
Total	**4**	**4.26**	**17**	**18.09**	**23**	**24.47**	**16**	**17.02**	**34**	**36.17**	**94**	**100.00**
Lack of time												
School A	1	3.03	5	15.15	11	33.33	12	36.36	4	12.12	33	100.00
School B	3	10.00	9	30.00	7	23.33	4	13.33	7	23.33	30	100.00
School C	1	3.23	3	9.68	9	29.03	3	9.68	15	48.39	31	100.00
Total	**5**	**5.32**	**17**	**18.09**	**27**	**28.72**	**19**	**20.21**	**26**	**28.46**	**94**	**100.00**
Limited support from the school management team												
School A	0	00.00	4	12.12	11	33.33	13	39.39	5	15.15	33	100.00
School B	3	10.00	7	23.33	11	36.67	5	16.67	4	13.33	30	100.00
School C	0	00.00	5	16.13	11	35.48	6	19.35	9	29.03	31	100.00
Total	**3**	**3.19**	**16**	**17.02**	**33**	**35.11**	**24**	**25.53**	**18**	**19.15**	**94**	**100.00**
Limited support from the government												
School A	0	00.00	0	00.00	2	6.06	25	75.76	6	18.18	33	100.00
School B	2	6.67	4	13.33	2	6.67	16	53.33	6	20.00	30	100.00
School C	0	00.00	2	6.45	4	12.90	6	19.35	19	61.29	31	100.00
Total	**2**	**2.13**	**6**	**6.38**	**8**	**8.51**	**47**	**50.00**	**31**	**32.98**	**94**	**100.00**
Negative attitudes towards the use of computers in teaching and learning												
School A	0	00.00	23	69.70	6	18.18	1	3.03	3	9.09	33	100.00
School B	12	40.00	5	16.67	8	26.67	1	3.33	4	13.33	30	100.00
School C	1	3.23	12	38.71	3	9.68	4	12.90	11	35.48	31	100.00
Total	**13**	**13.83**	**40**	**42.55**	**17**	**18.09**	**6**	**6.38**	**18**	**19.15**	**94**	**100.00**
Challenges to integrate ICTs in teaching												
School A	1	3.03	14	42.42	10	30.30	6	18.18	2	6.06	33	100.00
School B	4	13.33	13	43.33	4	13.33	5	16.67	4	13.33	30	100.00
School C	0	00.00	7	22.58	9	29.03	4	12.90	11	35.48	31	100.00

Total	**5**	**5.3**	**34**	**36.20**	**23**	**24.50**	**15**	**16.00**	**17**	**18.10**	**94**	**100.00**
Lack of confidence to use ICTs in teaching												
School A	1	3.03	17	51.52	7	21.21	3	9.09	5	15.15	33	100.00
School B	6	20.00	12	40.00	2	6.67	6	20.00	4	13.33	30	100.00
School C	1	3.23	12	38.71	3	9.68	4	12.90	11	35.48	31	100.00
Total	**8**	**8.51**	**41**	**43.62**	**12**	**12.77**	**13**	**13.83**	**20**	**21.28**	**94**	**100.00**
Lack of motivation to use ICTs in the classroom												
School A	0	00.00	18	54.55	11	33.33	1	3.03	3	9.09	33	100.00
School B	7	23.33	8	26.67	8	26.67	3	10.00	4	13.33	30	100.00
School C	1	3.23	12	38.71	3	9.68	4	12.90	11	35.48	31	100.00
Total	**8**	**8.51**	**38**	**40.43**	**22**	**23.40**	**8**	**8.51**	**18**	**19.15**	**94**	**100.00**
Inadequate maintenance of ICT hardware												
School A	0	00.00	2	6.06	3	9.09	23	69.70	5	15.15	33	100.00
School B	2	6.67	4	13.33	16	53.33	1	3.33	7	23.33	30	100.00
School C	1	3.23	1	3.23	9	29.03	6	19.35	14	45.16	31	100.00
Total	**3**	**3.19**	**7**	**7.45**	**28**	**29.79**	**30**	**31.91**	**26**	**28.46**	**94**	**100.00**
Limited access to ICTs among learners during teaching and learning												
School A	1	3.03	0	00.00	4	12.12	15	45.45	13	39.39	33	100.00
School B	3	10.00	0	00.00	9	30.00	8	26.67	10	33.33	30	100.00
School C	0	00.00	4	12.90	3	9.68	6	19.35	18	58.06	31	100.00
Total	**4**	**4.26**	**4**	**4.26**	**16**	**17.02**	**29**	**30.85**	**41**	**43.62**	**94**	**100.00**
Limited ICT skills among learners												
School A	2	6.06	24	72.73	2	6.06	3	9.09	2	6.06	33	100.00
School B	3	10.00	16	53.33	6	20.00	1	3.33	4	13.33	30	100.00
School C	8	25.81	6	19.35	6	19.35	0	00.00	11	35.48	31	100.00
Total	**13**	**13.83**	**46**	**48.94**	**14**	**14.89**	**4**	**4.26**	**17**	**18.09**	**94**	**100.00**
Limited ICT skills among respondents												
School A	3	9.09	4	12.12	6	18.18	7	21.21	13	39.39	33	100.00
School B	4	13.33	6	20.00	2	6.67	2	6.67	16	53.33	30	100.00
School C	4	12.90	3	9.68	8	25.81	4	12.90	12	38.71	31	100.00
Total	**11**	**11.70**	**13**	**13.83**	**16**	**17.02**	**13**	**13.83**	**41**	**43.62**	**94**	**100.00**

It can be deduced, from data in Table 8.27, that 9.57 per cent (N=9) respondents of the total sample indicated that inadequate training on ICT use in the teaching of their particular subjects was not an important barrier at all. School B had the largest percentage, 20.00 per cent (N=6), followed by School C, 6.45 per cent (N=2), and then School A, which had the smallest percentage, 3.03 per cent (N=1) such respondents. Respondents who indicated that inadequate ICT training was a less important barrier were 26.60 per cent (N=25) of the total sample. Most of them were School B respondents, 40.00 per cent (N=12), followed by School A, 27.27 per cent (N=9), and lastly School C, 12.90 per cent (N=4). Respondents who agreed that inadequate ICT training was an important barrier were 15.96 per cent (N=15) of the total sample. School A had the largest percentage of such respondents, 24.24 per cent (N=8), followed by School C, 19.35 per cent (N=6) and lastly School B, had the smallest percentage, 3.33 per cent (N=1) of such respondents. Those who responded that inadequate ICT training was a high important barrier were 23.40 per cent (N=22) of the total sample. Again, School A had the largest percentage, 33.33 per cent (N=11) followed by School C, 25.81 per cent (N=8) and then lastly School B, 10.00 per cent (N=3). 24.47 per cent (N=23) of the total sample indicated that inadequate training on ICT use in teaching was a very important barrier. Many of them were School C respondents, 35.48 per cent (N=11), followed by School B, with 26.67 per cent (N=8), and then lastly School A, which had the fewest 12.12 per cent (N=4) respondents.

Respondents who indicated that a school-based technician was not an important barrier at all were 9.57 per cent (N=9) of the total sample. School B had a larger percentage of such respondents, 16.67 per cent (N=5), than School C, which had 12.90 per cent (N=4) respondents. At School A, no respondent rated this barrier. Respondents who indicated that a school-based technician was less an important barrier were 11.70 per cent (N=11) of the total sample. School B had a larger percentage, 30.00 per cent (N=9), than School A, 6.06 per cent (N=2) of such respondents. At School C, no respondent rated this barrier. Those who responded that having a lack of a school-based ICT technician was a high important barrier were 24.47 per cent (N=23) of the total sample. Most of them were School A respondents, 33.33 per cent (N=11), followed by School C, 22.58 per cent (N=7), and then School B which had the fewest, 16.67 per cent (N=5) of such respondents. Respondents who responded that a lack of a school-based ICT technician was a very high barrier were 22.34 per cent (N=21) of the total sample. School C had the largest percentage, 38.71 per cent (N=12), followed by School A, 15.15 per cent (N=5), and lastly School B, 13.33 per cent (N=4). Most of the respondents rated this barrier from important to very high important a barrier.

Respondents who indicated that a limited supply of electricity was not an important barrier at all were 4.26 per cent (N=4) of the total sample. School B had a larger percentage, 10.00 per cent (N=3), than School C, 3.23 per cent (N=1) of such respondents. No School A respondent rated a limited supply of electricity. Those who agreed that a limited supply of electricity was a less important barrier were 6.38 per cent (N=6) of the total sample. The largest percentage were School A respondents, 9.09 per cent (N=3), followed by School C, 6.45 per cent (N=2) and then School B which had the smallest percentage, 3.33 per cent (N=1) of such respondents. Respondents who believed that a limited supply of electricity was an important barrier were 12.77 per cent (N=12) of the total sample. School B had 33.33 per cent (N=10), School C, 3.23 per cent (N=1) and School A, 3.03 per cent (N=1) such respondents. Thus, School B had the largest percentage of respondents and School A, had the smallest percentage of such respondents. Respondents who indicated that a limited supply of electricity was a high important barrier were 32.98 per cent (N=31) of the total respondents. School A had the largest percentage, 66.67 per cent (N=22), followed by School B, 23.33 per cent (N=7) and then School C, with the smallest percentage, 6.45 per cent (N=2) of such respondents. A group of 43.62 per cent (N=41) respondents agreed that a limited supply of electricity was a very high important barrier. Most of them were School C respondents, 80.65 per cent (N=25). School B had 30.00 per cent (N=9), and School A had the fewest, 21.21 per cent (N=7) of such respondents.

Respondents who indicated that inadequate access to high speed internet was not an important barrier at all were 3.19 per cent (N=3) of the total sample. School B had a larger percentage, 6.67 per cent (N=2), than School C, which had, 3.23 per cent (N=1) such respondents. Limited access to the internet was a less important barrier to 5.32 per cent (N=5) respondents of the total sample. School C had 9.68 per cent (N=3) and School B, 6.67 per cent (N=2) such respondents. Those who responded that inadequate access to high speed internet was an important barrier were 11.70 per cent (N=11) of the total sample. The largest percentage was at School B, 20.00 per cent (N=6), followed by School A, 9.09 per cent (N=3), and then School C, which had the smallest percentage, 6.45 per cent (N=2). Respondents who agreed that inadequate access to the internet was high important a barrier were 53.11 per cent (N=33) of the total sample. School A had the largest percentage, 63.64 per cent (N=21), followed by School B, 26.67 per cent (N=8), and lastly School C, 12.90 per cent (N=4). Respondents who agreed that limited access to high speed internet was a very high important barrier were 44.68 per cent (N=42) of the total sample. School C had the largest percentage, 67.74 per cent (N=21), followed by School B, 40.00 per cent (N=12) and then School A, 27.27 per cent (N=9). The majority of the respondents rated limited access to high speed internet from important to very high important a barrier, indicating that there was need for the infrastructure at schools.

Furthermore, respondents who indicated that a lack of educational software for particular subjects was not an important barrier at all were 4.26 per cent (N=4) of the total sample. School B had a larger percentage of such respondents, 10.00 per cent (N=3) than School C, 3.23 per cent (N=1). A lack of educational software was rated a less important barrier by 18.09 per cent (N=17) respondents of the total sample. Most of the respondents were at School B, 30.00 per cent (N=9), followed by School A, 15.15 per cent (N=5), and lastly School C, which had the fewest, 9.68 per cent (N=3) such respondents. Respondents who rated a lack of educational software an important barrier were 24.47 per cent (N=23) of the total sample. The majority of such respondents were at School A, 33.33 per cent (N=11), followed by School C, 22.58 per cent (N=7), and lastly School B, 16.67 per cent (N=5). There were 17.02 per cent (N=16) respondents of the total sample who indicated that a lack of educational software was a high important barrier. School B had a larger percentage 26.67 per cent (N=8) of such teachers, than School A, which had 24.24 per cent (N=8). Respondents who revealed that a lack of educational software was a very high important barrier were 36.17 per cent (N=34) of the total sample. School C had the largest percentage, 64.52 per cent (N=20), followed by School A, 27.27 per cent (N=9), and then School B which had the smallest percentage, 16.67 per cent (N=5) of such respondents.

A lack of time was identified by 5.32 per cent (N=5) respondents as not an important barrier at all. School B had the largest percentage, that is, 10.00 per cent (N=3) such respondents, followed by School C which had 3.23 per cent (N=1) and then School A, which had the smallest percentage, 3.03 per cent (N=1) of such respondents. Respondents who responded that a lack of time was a less important barrier were 18.09 per cent (N=17) of the total sample. School B had the largest percentage, 30.00 per cent (N=9), followed by School A, 15.15 per cent (N=5), and lastly School C, 9.68 per cent (N=3). Those who agreed that it was an important barrier were 28.72 per cent (N=27). The largest percentage was at School A which had 33.33 per cent (N=11), followed by School C with 29.03 per cent (N=9), and lastly School B, which had the smallest percentage, 23.33 per cent (N=7) of such respondents. A lack of time was regarded as a high important barrier by 20.21 per cent (N=19) respondents of the total sample. School A had the largest percentage, that is, 36.36 per cent (N=12), followed by School B, 13.33 per cent (N=4) and last School C, 9.68 per cent (N=3) respondents. Respondents who agreed that a lack of time was a very important barrier were 28.40 per cent (N=26) of the total sample. The largest percentage was at School C which had 48.39 per cent (N=15), followed by School B, with 23.33 per cent (N=7) and lastly School A, 12.12 per cent (N=4). It can, thus, be deduced that most respondents rated this barrier from important to a very high important barrier.

It was only School B respondents, 10.00 per cent (N=3), who rated that a limited support from the school management was not an important barrier at all. This might imply that Schools A and C respondents indicated that limited support from school management was a barrier. Respondents who indicated that it was a less important barrier were 17.02 per cent (N=16) of the total sample. School B had the largest percentage, that is, 23.33 per cent (N=7), followed by School C, 16.13 per cent (N=5), and lastly School A, which had the smallest percentage, 12.12 per cent, (N=4). A limited support from the school management was regarded as an important barrier by 35.11 per cent (N=33) of the total sample. The largest percentage of such respondents were at School B, 36.67 per cent (N=11), followed by School C, 35.48 per cent (N=11), and lastly School A, 33.33 per cent (N=11) respondents. Those who rated a lack of support from the school management as a high important barrier were 25.53 per cent (N=24) of the total sample. School A had the largest percentage, that is, 39.39 per cent (N=13), followed by School C, 19.35 per cent (N=6) and then School B with the smallest percentage, 16.67 per cent (N=5) of such respondents. To 19.15 per cent (N=18) respondents of the total sample, a lack of support from the school management was a very high barrier. School C had 29.03 per cent (N=9), which was the largest percentage, then School A, 15.15 per cent (N=5) and the smallest percentage was at School B, with 13.33 per cent (N=4) of such teachers. Hence, it can be concluded that a lack of support from the school management was an important to a very high important barrier to the use of ICTs in teaching.

It was only School B respondents, 2.13 per cent (N=2), who indicated that a limited support from the government was not an important barrier at all. This implies that School A and School C respondents felt that a limited support from the government was a barrier. Support from the government was rated as a less important barrier by 6.38 per cent (N=6) respondents of the total sample. School B had a larger percentage of such respondents, 13.33 per cent (N=4), than School C, which had 6.45 per cent (N=2) such respondents. Respondents who rated support from the government as an important barrier were 8.51 per cent (N=8) of the total sample. The largest percentage was at School C which had 12.90 per cent (N=4), followed by School B, 6.67 per cent (N=2), and lastly School A, 6.06 per cent (N=2) such respondents. Respondents who responded that a limited support from the government was a high important barrier were 50 per cent (N=47) of the total sample. School A had the largest percentage, 75.76 per cent (N=25), followed by School B, 53.33 per cent (N=16), and lastly School C, which had the smallest percentage, 19.35 per cent (N=6) of such respondents. Those who agreed that it was a very high important barrier were 32.98 per cent (N=31) of the total sample. The largest percentage was at School C, which had 61.29 per cent (N=19), followed by School B, 20.00 per cent (N=6), and lastly School A, with 18.18 per cent (N=6) such respondents. It can, therefore, be concluded that respondents needed more support from the government.

Respondents who indicated that respondents' negative attitudes towards computer use in teaching was not an important barrier at all were13.83 per cent (N=13) of the total sample. School B had 40.00 per cent (N=12) such respondents, and School C, 3.23 per cent (N=1). Thus, School B had a larger percentage of such respondents than School C. Some respondents, 42.55 per cent (N=40), indicated that it was a less important barrier to the use of ICTs in teaching. School A had the largest percentage, 69.70 per cent (N=23), followed by School C, 38.71 per cent (N=12), and then School B with the smallest percentage, 16.67 per cent (N=5). Those who rated respondents' negative attitudes as an important barrier were 18.09 per cent (N=17) of the total sample. The largest percentage was at School B which had 26.27 per cent (N=8), then came School A, 18.18 per cent (N=6), and lastly School C, 9.68 per cent (N=3) such respondents. Respondents who indicated that respondents' negative attitudes were a high important barrier were 6.38 per cent (N=6) of the total sample. School C had the largest percentage, that is, 12.90 per cent (N=4), then came School B which had 3.33 per cent (N=1), and School A with the smallest percentage, 3.03 per cent (N=1). Respondents who indicated that respondents' negative attitudes were a very high important barrier were 19.15 per cent (N=18). The largest percentage was at School C, 35.48 per cent (N=11), followed by School B with 13.33 per cent (N=4), and then lastly, School A, 9.09 per cent (N=3). Almost the same number of respondents rated attitudes as either a barrier or not a barrier.

It can further be deduced that a few respondents, 5.3 per cent (N=5) of the total sample, indicated that challenges to integrate ICTs in teaching were not an important barrier at all. School B had the largest percentage of such respondents, 13.13 per cent (N=4), followed by School A, which had 3.03 per cent (N=1). There were no such respondents at School C. Respondents who indicated that challenges to use ICTs in teaching were less important a barrier were 36.20 per cent (N=34). The largest percentage of such respondents were at School B, 43.33 per cent (N=13), followed by School A, 42.42 per cent (N=14), and lastly School C with 22.58 per cent (N=7) such respondents. Those who indicated that challenges to use ICTs in teaching were important a barrier to the use of ICTs in teaching were 24.50 per cent (N=23). The largest percentage were School A respondents, 30.30 per cent (N=10), followed by School C, 29.03 per cent (N=9), and lastly School B, 13.33 per cent (N=4). Respondents who indicated that challenges to use ICTs in teaching were 16.00 per cent (N=15) of the total sample. The largest percentage was at School A, 18.18 per cent (N=6), followed by School B, 16.67 per cent (N=5), and lastly School C, 12.90 per cent (N=4). 18.10 per cent (N=17) of the total sample that indicated that challenges to use ICTs in teaching were very high important a barrier. School C had 35.48 per cent (N=11), followed by School B, 13.33 per cent (N=4) and the fewest such respondents were at School A, 6.06 per cent (N=2).

A few respondents, 8.51 per cent (N=8) of the total sample, responded that a lack of confidence was not an important barrier at all. School B had the largest percentage, 20.00 per (N=6), then came School C, 3.23 per cent (N=1), and last School A, which had 3.03 per cent (N=1) such respondents. Some respondents, 43.62 per cent (N=41) of the total sample, regarded a lack of confidence as a less important a barrier. The largest percentage was at School A, 51.52 per cent (N=17), followed by School B, 40.00 per cent (N=12) and then School C, 38.71 (N=12) such respondents. Respondents who regarded a lack of confidence an important barrier were 12.77 per cent (N=12) of the total sample. School A had the largest percentage, 21.21 per cent (N=7), followed by School C, 9.68 per cent (N=3), and then School B, which had the smallest percentage, 6.67 per cent (N=2) of such respondents. A lack of confidence was rated a high important barrier by 13.83 per cent (N=13) respondents of the total sample. The largest percentage was at School B, 20.00 per cent (N=6), followed by School C, 12.90

per cent (N=4), and lastly School A, 9.09 per cent (N=3). Respondents who indicated that a lack of confidence was a very high important barrier were 21.28 per cent (N=20). Most of them were School C respondents, 35.48 per cent (N=11), School A had 15.15 per cent (N=5), and School B had the fewest, 13.33 per cent (N=4) of such respondents.

Furthermore, a lack of motivation among respondents to use ICTs in the classroom was regarded as an unimportant barrier at all by 8.51 per cent (N=8) respondents of the total sample. School B had 23.33 per cent (N=7), and School C, 3.23 per cent (N=1) such respondents. Therefore, School B had a larger percentage than School C. Respondents who indicated that a lack of motivation was a less important barrier were 40.43 per cent (N=38) of the total sample. School A, had the largest percentage, 54.55 per cent (N=18), followed by School C, 38.71 per cent, (N=12) and then School B with the smallest percentage, 26.67 per cent (N=8). Respondents who indicated that a lack of motivation was an important barrier were 23.40 per cent (N=22) of the total sample. Again, School A had the largest percentage, 33.33 per cent (N=11), followed by School B, 26.67 per cent (N=8) and lastly School C, 9.68 per cent (N=3) of such respondents. Those who indicated that a lack of motivation was high important a barrier were 8.51 per cent (N=8) of the total sample. The largest percentage was at School C, 12.90 per cent (N=4), followed by School B, 10.00 per cent (N=3) and then School A with the smallest percentage, 3.03 per cent (N=1) of such respondents. A lack of motivation was rated a very high important barrier by 19.15 per cent (N=18) respondents of the total sample. School C had the largest percentage, 35.48 per cent (N=11), then came School B, 13.33 per cent (N=4), and last School A, 9.09 per cent (N=3) such respondents.

Respondents who indicated that inadequate maintenance of ICT hardware was not an important barrier at all were 3.19 per cent (N=3) of the total sample. School B had a larger percentage, 6.67 per cent (N=2), than School C, which had 3.23 per cent (N=1) of such respondents. Respondents who indicated that it was a less important barrier were 7.45 per cent (N=7) of the total sample. School B had the largest percentage, 13.33 per cent (N=4), followed by School A, 6.06 per cent

(N=2), and lastly School C, which had the smallest percentage, 3.23 per cent (N=1) of such respondents. Inadequate maintenance of ICT hardware was regarded as an important barrier by 29.79 per cent (N=28) respondents of the total sample. The majority of respondents were at School B, 53.33 per cent (N=16), followed by School C, 29.03 per cent (N=9), and lastly the fewest were at School A, 9.09 per cent (N=3). Some respondents, 31.91 per cent (N=30), indicated that it was high a barrier to the use of ICTs in teaching. School A had the largest percentage of such respondents, 69.70 per cent (N=23), followed by School C, 19.53 per cent (N=6) and then School B, 3.33 per cent (N=1). Those who regarded inadequate maintenance as a very high important barrier were 28.46 per cent (N=26) of the total sample. School C had the largest percentage, 45.16 per cent (N=14), followed by School B, 23.33 per cent (N=7), and lastly School A with the smallest percentage, 15.15 per cent (N=5) of such respondents.

Respondents who indicated that a limited access to ICTs among learners was not a barrier at all were 4.26 per cent (N=4) of the total sample. School B had a larger percentage, 10.00 per cent (N=3), than School A, which had 3.03 per cent (N=1). Only School C respondents, 4.26 per cent (N=4), indicated that a limited access to ICT among learners was a less important barrier. Those who rated a limited access to ICTs among learners an important barrier were 17.02 per cent (N=16) of the total sample. School B had the largest percentage, 30.00 per cent (N=9), followed by School A, 12.12 per cent (N=4), and then School C with the smallest percentage, 9.68 per cent (N=3) of such learners. 30.85 per cent (N=29) respondents indicated that a limited access to technologies among learners was a high important barrier. Most of the respondents were at School A, 45.45 per cent (N=15), followed by School B, 26.67 per cent (N=8), and then the fewest were from School C, 19.35 per cent (N=6) respondents. To 43.62 per cent (N=41) respondents, a limited access to technologies among learners was a very high important barrier. School C had the largest percentage, 58.06 per cent (N=18), then came School A which had 39.39 per cent (N=13), and last School B, 33.33 per cent (N=10).

13.83 per cent (N=13) respondents agreed that limited ICT skills among learners were not at all an important barrier. School C had the largest percentage, 25.81 (N=8), School B 10.00 per cent (N=3), and School A had the smallest percentage, 6.06 per cent (N=2) of such respondents. Some respondents, 48.94 per cent (N=46) of the total sample, indicated that limited ICT skills among learners were a less important barrier. The majority of them were from School A, 72.73 per cent (N=24), followed by School B, 53.33 per cent (N=16), and then School C with the fewest, 19.35 per cent (N=6) of such respondents. Respondents who regarded limited skills as an important barrier were 14.84 per cent (N=14) of the total sample. School B had the largest percentage, 20.00 per cent (N=6), School C 19.35 per cent (N=6), then School A had the smallest percentage, 6.06 (N=2) of such respondents. Those who indicated that limited ICT skills among learners were a high important barrier were 4.26 per cent (N=4) of the total sample. School A had a larger percentage, 9.09 per cent (N=3), than School B, which had 3.33 per cent (N=1) such respondents. Respondents who indicated that limited ICT skills among learners were very high an important barrier were 18.09 per cent (N=17) of the total sample. School C had the largest percentage, 35.48 per cent (N=11), followed by School B, 13.33 per cent (N=4), and then School A with the smallest percentage, 6.06 per cent (N=2) of such respondents.

Furthermore, respondents who indicated that limited ICT skills among teachers were not an important barrier at all were 11.70 per cent (N=11) of the total sample. School B, had the largest percentage, 13.33 per cent (N=4), followed by School C, 12.90 per cent (N=4) and then School A which had the smallest percentage, 9.09 per cent (N=3) of such respondents. Some of the respondents, 13.83 per cent (N=13), indicated that limited ICT skills were a less important barrier. The largest percentage of such respondents were at School B, 20.00 per cent (N=6), then came School A, 12.12 per cent (N=4), and last School C with the smallest percentage, 9.68 per cent (N=3). Respondents who indicated that limited ICT skills among respondents were an important barrier were 17.02 per cent (N=16) of the total sample. The largest percentage was at School C, 25.81 per cent (N=8), followed by School A with 18.18 per cent (N=6), and then School B which had the smallest percentage, 6.67 per cent (N=2) of such respondents.

Respondents who agreed that limited ICT skills were a high important barrier were 13.83 per cent (N=13) of the total sample. School A had the largest percentage, 21.21 per cent (N=7), then came School C, 12.90 per cent (N=4), and last School B which had the smallest percentage, 6.67 (N=2) of such respondents. Those whose responses indicated that inadequate ICT skills among respondents were a very high barrier were 43.62 per cent (N=41) of the total sample. The largest percentage of such respondents were at School B, 53.33 per cent (N=16), followed by School A, 39.39 per cent (N=13) and then the smallest percentage of such respondents was at School C, 38.71 per cent (N=12). Thus, most respondents rated ICT skills as important to very high important a barrier.

Table 8. 28: Mean scores for perceptions of barriers to ICTs adoption and use in schools

	School A N=33		**School B N=30**		**School C N=31**		**Total N=94**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Inadequate training on ICT use in the teaching of my particular subject	3.24	1.09	2.83	1.56	3.71	1.27	3.27	1.35
Lack of a school-based technician	3.58	0.83	2.80	1.30	3.74	1.34	3.38	1.23
Limited supply of electricity	4.00	0.79	3.60	1.25	4.55	1.06	4.05	1.10
Limited access to high speed internet	4.18	0.58	3.87	1.22	4.32	1.17	4.13	1.03
Lack of educational software for my particular subject	3.64	1.06	3.10	1.30	4.13	1.26	3.63	1.26
Lack of time	3.39	0.10	3.10	1.35	3.90	1.22	3.47	1.22
Limited support from the school management team	3.58	0.90	3.00	1.17	3.61	1.09	3.40	1.08
Limited support from the government	4.12	0.49	3.67	1.16	4.35	0.95	4.05	0.93
Negative attitudes towards the use of computers in teaching and learning	2.52	0.94	2.33	1.40	3.39	1.41	2.74	1.33

Challenges to integrate ICTs in teaching	2.82	0.98	2.73	1.29	3.61	1.20	3.05	1.21
Lack of confidence to use ICTs in teaching	2.82	1.16	2.67	1.37	3.39	1.41	2.96	1.34
Lack of motivation to use ICTs in the classroom	2.67	0.92	2.63	1.33	3.39	1.41	2.89	1.27
Inadequate maintenance of ICT hardware	3.94	0.70	3.23	1.17	4.00	1.10	3.73	1.05
Limited access to ICTs among learners during teaching and learning	4.18	0.88	3.73	1.23	4.23	1.09	4.05	1.08
Limited ICT skills among learners	2.36	0.96	2.57	1.17	3.00	1.65	2.64	1.30
Limited ICT skills among teachers	3.70	1.36	3.67	1.61	3.55	1.43	3.64	1.45

Overall, four items out of 16 had mean scores which ranged from 2.64 to 2.96, which indicates that those items were less important barriers to the adoption and use of ICTs. Eight items had mean scores which ranged from 3.27 to 3.64, indicating that the items were important barriers to the adoption of ICTs. Four items had mean scores ranging from 4.05 to 4.13, indicating that the items were high important barriers to the adoption and use of ICTs in teaching and learning.

Limited ICT skills, negative attitudes towards ICTs, a lack of confidence and a lack of motivation to use ICTs in teaching and learning had low mean scores, which ranged from 2.64 to 2.96. This indicated that teachers believed that these were relatively less important barriers to the use of ICTs in teaching. However, mean scores for these four barriers at School C were all above midpoint 3, indicating that they were important barriers to the adoption of ICTs at the school. The other two schools had mean scores below midpoint 3 but above 2, indicating that the barriers were less important.

Inadequate training on ICT use in teaching, a lack of a school based technician, a lack of educational software for teachers, a lack of time, a limited support from the school management team, challenges to the integration of ICTs, inadequate maintenance of ICT hardware and limited skills among teachers had mean scores which ranged from 3.27 to 3.64, indicating that they were important barriers to the adoption and use of ICTs in the classroom. As far as inadequate training and a lack of a school-based technician were concerned, only School B had mean scores which were below the midpoint 3 but above 2, indicating that these barriers were less important. A lack of educational software and inadequate maintenance of ICT hardware were both high important barriers at School C, which had mean scores above 4, whereas at the other two schools, mean scores were above midpoint 3 but below 4. It was only School C teachers who believed that challenges to integrate ICTs were important barriers. Schools A and B teachers indicated that such a barrier was of less importance.

A limited supply of electricity, a limited access to high speed internet, a limited support from the government and a limited access to ICTs among learner had mean scores which ranged from 4.05 to 4.13, indicating that they were very important barriers to the adoption and use of ICTs in teaching. Schools A and C both had mean scores above 4 for all the four barriers, indicating that the barriers were very important. School B recorded mean scores which were above the midpoint 3 but below 4, indicating that they were important barriers to the use of ICTs in teaching.

8.15 Composite scale for perceptions of barriers to integrating ICTs in teaching and learning

Also in the case of perceptions of barriers to ICT integration, a principal factor analysis with varimax rotation was conducted. Only factor loadings of 0.4 or above were taken into account. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was a satisfactory 0.890, indicating that a problem with multi-collinearity is unlikely. Initially three factors were extracted. Inspection of the three factors, however, showed that the third factor did not make theoretical sense, whereupon a two-factor solution – as displayed in Table 8.29 – was extracted. The first factor explained 54.620% of the variance and the second 12.762%. In compiling two composite measures, a particular item was grouped with the factor on which it had the highest loading. However, as item E1.16 had a negative loading on Factor 2 – in contrast with the other items loading on this factor – it was not included in the composite scale. Although item E1.6 had the highest loading on Factor 1, it was also included in the composite measure for Factor 2, as it also loaded on this factor and can be theoretically linked to both factors as has been pointed in the qualitative interviews. A Cronbach alpha of .917 was reported for the composite scale for Factor 1 and for the scale related to Factor 2 the Cronbach alpha was a still satisfactory .752.

Table 8. 29: Results of factor analysis for perceptions of barriers to ICTs adoption and use in teaching

	Factor 1	Factor 2
E1.1 Barriers to adoption/use of ICTs - Inadequate training on ICT use in the teaching of my particular subject	.692	
E1.2 Barriers to adoption/use of ICTs - Lack of a school-based technician	.705	
E1.3 Barriers to adoption/use of ICTs - Limited supply of electricity	.838	
E1.4 Barriers to adoption/use of ICTs - Limited access to high speed internet	.738	
E1.5 Barriers to adoption/use of ICTs - Lack of educational software for my particular subject (e.g. games)	.583	.505
E1.6 Barriers to adoption/use of ICTs - Lack of time	.648	.470
E1.7 Barriers to adoption/use of ICTs - Limited support from the school management team	.576	.497
E1.8 Barriers to adoption/use of ICTs - Limited support from the government	.736	
E1.9 Barriers to adoption/use of ICTs - Negative teacher attitudes towards the use of computers in teaching and learning		.837
E1.10 Barriers to adoption/use of ICTs - Challenges to integrate ICTs in teaching	.557	.696
E1.11 Barriers to adoption/use of ICTs - Lack of confidence to use ICTs in teaching	.490	.730
E1.12 Barriers to adoption/use of ICTs - Lack of motivation to use ICTs in the classroom	.458	.755
E1.13 Barriers to adoption/use of ICTs - Inadequate maintenance of ICT hardware	.604	.468
E1.14 Barriers to adoption/use of ICTs - Limited access to ICTs among learners during teaching and learning	.803	
E1.15 Barriers to adoption/use of ICTs - Limited ICT skills among learners		.924
E1.16 Barriers to adoption/use of ICTs - Limited ICT skills among teachers		-.785

8.15.1 Infrastructure and support-related challenges

The composite measure for Factor 1 - Infrastructure and Support-related Challenges - dealt with challenges related to infrastructure, training and support. Scores could vary between 50 and 5, and higher scores indicate that teachers experienced higher levels of stress due to these challenges.

Table 8. 30: Mean scores for Infrastructure and Support-related Challenges

School	Mean	N	Std. Deviation
A	37.85	33	4.963
B	32.93	30	9.741
C	40.55	31	9.092
Total	37.17	94	8.631

The mean scores as reported in Table 8.30 indicated that teachers at School C experienced the highest levels of stress due to these challenges. A univariate analysis of variance (ANOVA) indicated that there were indeed statistically significant differences between the three schools (F(2.93) =6.859; p=.002; eta=/131). Post-hoc Scheffe tests revealed two homogeneous subsets. School A and School B fall in the first subset, indicating that although School B had the lowest mean, the differences between the two schools were not statistically significant. School A also overlapped with School C in the second subset, indicating that the differences between these two schools were also not statistically significant. However, the mean of School C was significantly higher than that of School B, indicating that infrastructure and support-related factors were significantly more challenging at School C. The effect size of 1.31% is, however, relatively low. A univariate analysis of variance (ANOVA) investigating differences for demographic factors (gender, age, highest educational qualification and years of experience), however, revealed no significant differences (F(26, 91) =1.435; p=.121; eta=.365).

Table 8. 31: Mean scores for Attitudinal, Motivational and Time-related Challenges

School	Mean	N	Std. Deviation
A	16.58	33	4.235
B	16.03	30	6.805
C	20.68	31	7.842
Total	17.76	94	6.689

The scores for this variable could vary between 30 and 5, with higher scores indicating the experience of more challenges on this level. The means for this measure are reported in Table 8.31. School C also had the highest mean for this factor, indicating that teachers at School C experienced significantly more challenges on this level. A univariate analysis of variance (ANOVA) also indicated statistically significant differences between the three schools ($F(2, 93)=4.833$; $p=.010$; eta=.096). Also in this case, post-hoc Scheffe tests revealed two homogenous subsets. School A and School B fall in the first subset, indicating no significant differences between these two schools. The mean scores of School A and School B were, however, significantly lower than those of School C in the second subset. Although the effect size is relatively low (0.96%), the conclusion can be drawn that the overall motivation to use ICTs in teaching and learning was significantly lower at School C. As in the case of infrastructure and support-related factors, a univariate analysis of variance (ANOVA) investigating differences for demographic factors (gender, age, highest educational qualification and years of experience), however, revealed no significant differences ($F(26, 92)=1.017$; $p=.461$; eta=.289).

8.16 Respondents' perceptions with regard to the impact of ICTs use in teaching and learning

The third sub-research objective of this study sought to establish factors that influenced the integration of ICTs in teaching and learning. Integration of ICTs in the classroom might be influenced by the teachers' perceptions on the impact of technologies in teaching. Table 8.32 thus presents data on respondents' responses on their perceptions on the impact of technology on teaching and learning.

Table 8. 32: The impact of ICTs in teaching and learning

ICTs adoption and use in the classroom	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total	
	5		4		3		2		1			
	N	%	N	%	N	%	N	%	N	%	N	%
ICTs are disruptive when teaching												
School A	2	6.06	9	27.27	3	9.09	16	48.48	3	9.09	33	100.00
School B	6	20.00	10	33.33	3	10.00	10	33.33	1	3.33	30	100.00
School C	1	3.23	11	35.48	4	12.90	14	45.16	1	3.23	31	100.00
Total	**9**	**9.57**	**30**	**31.91**	**10**	**10.64**	**40**	**42.55**	**5**	**5.32**	**94**	**100.00**
ICTs make teaching effective												
School A	0	00.00	0	00.00	9	27.27	17	51.52	7	21.21	33	100.00
School B	0	00.00	2	6.67	5	16.67	17	56.67	6	20.00	30	100.00
School C	0	00.00	0	00.00	3	9.68	15	48.39	13	41.94	31	100.00
Total	**00**	**00.00**	**2**	**2.13**	**17**	**18.09**	**49**	**52.13**	**26**	**27.66**	**94**	**100.00**
ICTs promote learner to learner interaction												
School A	0	00.00	0	00.00	9	27.27	17	51.52	7	21.21	33	100.00
School B	0	00.00	0	00.00	9	30.00	15	50.00	6	20.00	30	100.00
School C	0	00.00	0	00.00	4	12.90	15	48.38	12	38.71	31	100.00
Total	**00**	**00.00**	**00**	**00.00**	**22**	**23.40**	**47**	**50.00**	**25**	**26.60**	**94**	**100.00**
ICTs help in improving learner performance												
School A	1	3.03	1	3.03	10	30.30	14	42.42	7	21.21	33	100.00
School B	0	00.00	2	6.67	6	20.00	14	46.67	8	26.67	30	100.00
School C	0	00.00	1	3.23	6	19.35	16	51.61	8	25.81	31	100.00
Total	**1**	**1.06**	**4**	**4.26**	**22**	**23.40**	**44**	**46.81**	**23**	**24.47**	**94**	**100.00**
Use of ICTs' in teaching and learning can improve learners' critical thinking												
School A	0	00.00	0	00.00	12	36.36	14	42.42	7	21.21	33	100.00
School B	0	00.00	0	00.00	11	36.67	15	50.00	4	13.33	30	100.00

School C	0	00.00	0	00.00	5	16.13	15	48.39	11	35.48	31	100.00
Total	**00**	**00.00**	**00**	**00.00**	**28**	**29.79**	**44**	**46.81**	**22**	**23.40**	**94**	**100.00**
Knowing how to use ICTs by teachers is a good skill												
School A	0	00.00	0	00.00	4	12.12	7	21.21	22	66.67	33	100.00
School B	0	00.00	0	00.00	7	23.33	12	40.00	11	36.67	30	100.00
School C	0	00.00	0	00.00	2	6.45	13	41.94	16	51.61	31	100.00
Total	**0**	**00.00**	**0**	**00.00**	**13**	**13.83**	**32**	**34.04**	**49**	**52.13**	**94**	**100.00**
Use of ICT tools in the classroom is beneficial in teaching and learning of my subject area												
School A	00	00.00	00	00.00	14	42.42	11	33.33	8	24.24	33	100.00
School B	00	00.00	00	00.00	6	20.00	13	43.33	9	30.00	30	100.00
School C	1	3.23	1	3.23	2	6.45	11	35.48	15	48.39	30	96.77
Total	**1**	**3.23**	**1**	**3.23**	**22**	**23.40**	**35**	**37.23**	**34**	**36.17**	**93**	**98.93**
ICTs make lesson plans richer												
School A	00	00.00	00	00.00	11	33.33	11	33.33	11	33.33	33	100.00
School B	1	3.33	00	00.00	6	20.00	9	30.00	14	46.67	30	100.00
School C	00	00.00	00	00.00	5	16.13	11	35.48	15	48.39	31	100.00
Total	**1**	**1.06**	**00**	**00.00**	**22**	**23.40**	**31**	**32.98**	**40**	**42.55**	**94**	**100.00**
ICTs help respondents save time during lesson preparation												
School A	1	3.03	0	00.00	12	36.36	15	45.45	5	15.15	33	100.00
School B	0	00.00	3	10.00	7	23.33	9	30.00	11	36.67	30	100.00
School C	1	3.23	3	9.68	5	16.13	10	32.26	12	38.71	31	100.00
Total	**2**	**2.13**	**6**	**6.38**	**24**	**25.53**	**34**	**36.17**	**28**	**29.79**	**94**	**100.00**
Use of ICTs puts more work on teachers												
School A	5	15.15	12	36.36	11	33.33	3	9.09	2	6.06	33	100.00
School B	1	3.33	7	23.33	7	23.33	10	33.33	5	16.67	30	100.00
School C	3	9.68	9	29.06	9	29.03	9	29.03	1	3.23	31	100.00
Total	**9**	**9.57**	**28**	**29.79**	**27**	**28.72**	**22**	**23.40**	**8**	**8.51**	**94**	**100.00**
ICTs arouse learner curiosity in the learning process												
School A	1	3.13	1	3.13	14	43.75	8	25.00	8	25.00	33	100.00
School B	1	3.33	3	10.00	5	16.67	9	30.00	12	40.00	30	100.00
School C	1	3.23	1	3.23	4	12.90	9	29.03	16	51.61	31	100.00

Total	**3**	**3.23**	**5**	**5.38**	**23**	**24.73**	**26**	**27.96**	**36**	**38.71**	**93**	**98.94**
ICTs help me to address varying needs of learners												
School A	00	00.00	00	00.00	10	30.30	13	39.39	10	30.30	33	100.00
School B	1	3.33	00	00.00	8	26.67	10	33.33	11	36.67	30	100.00
School C	1	3.33	00	00.00	3	9.68	12	38.71	15	48.39	31	100.00
Total	**2**	**2.13**	**00**	**00.00**	**21**	**22.34**	**35**	**37.23**	**36**	**38.30**	**94**	**100.00**
Use of ICTs in teaching is enjoyable												
School A	1	3.03	1	3.03	7	21.21	8	24.24	16	48.48	33	100.00
School B	00	00.00	00	00.00	6	20.00	12	40.00	12	40.00	30	100.00
School C	2	6.45	00	00.00	1	3.23	14	45.16	14	45.16	31	100.00
Total	**3**	**3.19**	**1**	**1.06**	**14**	**14.89**	**34**	**36.17**	**42**	**44.68**	**94**	**100.00**
Using ICTs in teaching is difficult												
School A	3	9.09	15	45.45	12	36.36	1	3.03	2	6.06	33	100.00
School B	2	6.67	11	36.67	7	23.33	7	23.33	3	10.00	30	100.00
School C	3	9.68	14	45.16	7	22.58	7	22.58	00	00.00	31	100.00
Total	**8**	**8.51**	**40**	**42.55**	**26**	**27.66**	**15**	**15.96**	**5**	**5.32**	**94**	**100.00**
I am hesitant to use ICTs in teaching and learning												
School A	5	15.15	4	12.12	6	18.18	11	33.33	7	21.21	33	100.00
School B	5	16.67	6	20.00	4	13.33	7	23.33	8	26.67	30	100.00
School C	4	12.90	3	9.68	5	16.13	10	32.26	9	29.03	31	100.00
Total	**14**	**14.89**	**13**	**13.83**	**15**	**15.96**	**28**	**29.79**	**24**	**25.53**	**94**	**100.00**
I do not believe that the use of ICTs will benefit my teaching												
School A	7	21.21	3	9.09	9	27.27	5	15.15	9	27.27	33	100.00
School B	5	16.67	4	13.33	5	16.67	7	23.33	9	30.00	30	100.00
School C	7	22.58	4	12.90	8	25.81	6	19.35	6	19.35	31	100.00
Total	**19**	**20.21**	**11**	**11.70**	**22**	**23.40**	**18**	**19.15**	**24**	**25.53**	**94**	**100.00**

It can be deduced, from data in Table 8.32, that 9.57 per cent (N=9) respondents of the total sample strongly agreed that ICTs were disruptive. School B had the largest percentage of such respondents, 20.00 per cent (N=6), followed by School A, 6.06 per cent (N=2), and then School C which had the smallest percentage, 3.23 per cent (N=1) of such respondents. Those who responded by indicating that ICTs were disruptive were 31.91 per cent (N=30) of the total sample. Most of them were at School C, 35.48 per cent (N=11), followed by

School B, 33.33 per cent (N=10), and lastly School A which had the fewest, 27.27 per cent (N=9) of such respondents. Respondents who were uncertain were 10.64 per cent (N=10) of the total respondents. The largest percentage was from School C respondents, 12.90 per cent (N=4), followed by School B, 10.00 per cent (N=3), and then School A which had the smallest percentage, 9.09 per cent (N=3) of such respondents. Respondents who disagreed that ICTs were disruptive were 42.55 per cent (N=40) of the total sample. The largest percentage of such respondents were at School A, 48.48 per cent (N=16), followed by School C, 45.16 per cent (N=14), and lastly School which had the smallest percentage, 33.33 per cent (N=10) of such respondents. Those who strongly disagreed were 5.32 per cent (N=5) of the total sample. School A had the largest percentage, 9.09 per cent (N=3), followed by School B, 3.33 per cent (N=1), then School C had the smallest percentage, 3.23 per cent (N=1).

No respondent from Schools A, B and C strongly agreed that ICTs made teaching effective. Only School B, 2.13 per cent (N=2) respondents agreed that ICTs made teaching effective. 18.09 per cent (N=17) respondents were uncertain of the effect of ICTs on teaching. School A had the largest percentage, 27.27 per cent (N=9) of such respondents, School B had 16.67 per cent (N=5), and School C had the smallest percentage, 9.68 per cent (N=3) of such respondents. Respondents who disagreed that ICTs made teaching effective were 52.13 per cent (N=49) of the total sample. School B had the majority of such respondents, 56.67 per cent (N=17), followed by School A, 51.52 per cent (N=17) and School C had the fewest, 48.39 per cent (N=15) of such respondents. Some respondents strongly disagreed that ICTs made teaching effective, and they were 27.66 per cent (N=26) of the total sample. Most of them were School C respondents, 41.94 (N=13), followed by School A 21.21 per cent (N=7), and lastly School B, which had the fewest, 20.20 per cent (N=6) of such respondents.

There were no respondents who either agreed or strongly agreed that ICTs promoted learner to learner interaction at all the three schools. Those who were uncertain were 23.40 per cent (N=22) of the total respondents. School B had the largest percentage of such respondents, 30.00 per cent (N=9), then came School

A, 27.27 per cent (N=9) and last School C, which had the smallest, 12.90 per cent (N=4) of such respondents. Respondents who disagreed that ICTs promoted learner to learner interaction were 50.00 per cent (N=47) of the total respondents. Most of them were School A, 51.52 per cent (N=17) respondents, followed by School B, 50.00 per cent (N=15), and lastly, School C had the fewest, 48.38 per cent (N=15) of such respondents. Respondents who strongly disagreed that ICTs promoted learner to learner interaction were 26.60 per cent (N=25) of the total sample. The largest percentage was School C respondents, 38.71 per cent (N=12), followed by School A, 21.21 per cent (N=7), and then School B with the smallest percentage, 20.00 per cent (N=6) such respondents.

It can further be deduced, from the data in Table 8.32, that a respondent, 1.06 per cent (N=1) of the total sample, strongly agreed that ICTs helped in improving learner performance. That responded was from School A. Those who agreed were 4.26 per cent (N=4) of the total sample. School B had the largest percentage of such respondents, 6.67 per cent (N=2), followed by School C, 3.23 percent (N=1) and lastly School A, 3.03 per cent (N=1). The uncertain respondents were 23.40 per cent (N=22) of the total sample. Most of them were from School A, 30.30 per cent (N=10), next School B, 20.00 per cent (N=6), and lastly School C, 19.35 per cent (N=6) such respondents. Those who disagreed were 46.81 per cent (N=44) of the total sample. School C had the largest percentage of such respondents, 51.61 per cent (N=16), followed by School B, 46.67 per cent (N=14), and then School A with the smallest percentage, 42.42 per cent (N=14) of such respondents. Some respondents indicated that they strongly disagreed that ICTs helped in improving learner performance, that is, 24.47 per cent (N=23). Most of them were School B respondents, 26.67 per cent (N=8), followed by School C, 25.81 per cent (N=8) and then School A which had the fewest of such respondents, 21.21 per cent (N=7).

It can also be deduced, from Table 8.32, that neither did respondents at Schools A, B and C strongly agree nor did they agree, that the use of ICTs in teaching and learning can improve learners' critical thinking. Respondents who were uncertain that the use of ICTs in teaching and learning can improve learners' critical thinking were 29.79 per cent (N=28). The largest percentage came School B teachers, 36.67 per cent (N=11), followed by School A, 36.36 per cent (N=12), and lastly School C, 16.13 per cent (N=5). Those who disagreed were 46.81 per cent (N=44). School B had the largest percentage, 50.00 per cent (N=15) such respondents, then School C with 48.39 per cent (N=15), and School A which had the smallest percentage, 42.42 percentage (N=14) such respondents. Some respondents strongly disagreed that using ICTs in the classroom can improve learners' critical thinking. The largest percentage was from School C teachers, 35.48 per cent (N=11), followed by School A with 21.21 per cent (N=7), and then School B, 13.33 per cent (N=4).

Respondents who strongly disagreed that knowing how to use ICTs was a good skill were 52.13 per cent (N=49) of the total sample. The majority of them was from School A respondents, 66.67 per cent (N=22), followed by School C, 51.61 per cent (N=16), and School B had the fewest, 36.67 per cent (N=11) of such respondents. Those who disagreed were 34.04 per cent (N=32) of the total sample. School C had the largest percentage, 41.94 per cent (N=13), then School B, 40.00 per cent (N=12), and lastly School A, which had the smallest percentage, 21.21 per cent (N=7) of such respondents. The uncertain respondents were 13.83 per cent (N=13) of the total sample. School B had the largest percentage, 23.33 per cent (N=7), followed by School A, 12.12 per cent (N=4) and then School C with the smallest percentage, 6.45 per cent (N=2) of such respondents. There were no respondents who either agreed or strongly agreed that knowing how to use ICTs was a good skill.

A respondent, 3.23 per cent (N=1) at School C strongly agreed that the use of ICT tools in the classroom was beneficial in teaching and learning of their subject area. No respondent at Schools A and School B strongly agreed. Also, at School C, a respondent, 3.23 per cent (N=1) agreed that the use of ICT tools in the classroom was beneficial in teaching and learning of their subject area. There were no such respondents at both Schools A and B. Those who strongly disagreed that the use of ICT tools in the classroom was beneficial in the teaching and learning of their subject area were 36.17 per cent (N=34) of the total respondents. The majority of those respondents was from School C teachers, that is, 54.84 per cent (N=17), followed by School B, 30. 00 per cent (N=9), and lastly School A which had the fewest, 24.24 per cent (N=8) such respondents. Those who disagreed were 37.23 per cent (N=35) respondents. Most of them were School B respondents, 43.33 per cent (N=13), followed by School C, 35.48 per cent (N=11), and lastly School A with the least percentage, 33.33 per cent (N=11) of such respondents. Respondents who were uncertain were 23.40 per cent (N=22) of the total sample. School A respondents constituted the largest percentage of uncertain respondents, that is, 42.42 per cent (N=14), followed by School B, 20.00 per cent (N=6), and lastly School C, with the smallest percentage, 6.45 per cent (N=2) of such respondents.

Only a School B respondent, 1.06 per cent (N=1) strongly agreed that ICTs made lesson plans richer. There were no respondents who agreed that ICTs made lesson plans richer. Respondents who were uncertain were 23.40 per cent (N=22) of the total sample. School A had the largest percentage, 33.33 per cent (N=11), followed by School B, 20.00 per cent (N=6) and lastly School C, 16.13 per cent (N=5) such respondents. Respondents who strongly disagreed that ICTs made lesson plans richer were 42.55 per cent (N=40) of the total sample. Most of them were School C respondents, 48.39 (N=15), followed by School B, 46.67 per cent (N=14), and then lastly School A, 33.33 per cent (N=11) such respondents. Those who disagreed with that view were 32.98 per cent (N=31) of the total sample. School C had the largest percentage, 35.48 per cent (N=11), followed by School A, 33.33 per cent (N=11), and then School B which had the smallest percentage, 30.00 per cent (N=9) of such respondents.

Respondents who strongly agreed that ICTs help in saving time during lesson preparation were 2.13 per cent (N=2) of the total sample. School C had a larger percentage, 3.23 per cent (N=1), than School A, which had 3.03 per cent (N=1) such respondents. Respondents who agreed were 6.38 per cent (N=6) of the total sample. School B had a larger percentage, 10.00 per cent (N=3), than School C, which had 9.68 per cent (N=3) such respondents. Respondents who were uncertain were 25.53 per cent (N=24) of the total sample. School A had the largest percentage, 36.36 per cent (N=12), followed by School B, 23.33 per cent (N=7), and lastly School C had the smallest percentage, 16.13 per cent (N=5) of such respondents. Those who disagreed were 36.17 per cent (N=34) of the total sample. The largest percentage was from School A respondents, 45.45 per cent (N=15), followed by School C, 32.26 per cent (N=10), and lastly School B which had the smallest percentage, 30.00 per cent (N=9) of such respondents. Respondents who strongly disagreed were 29.79 per cent (N=28) of the total sample. School C had the largest percentage, 38.71 per cent (N=12), followed by School B, 36.67 per cent (N=11) and lastly School A with the smallest percentage, 15.15 per cent (N=5) of such respondents. It can, thus, be concluded that using ICTs took a lot of lesson preparation time.

Respondents who strongly agreed with the view that the use of ICTs put more work on teachers were 9.57 per cent (N=9) of the total sample. School A had the largest percentage, 15.15 per cent (N=5) of such respondents, followed by School C, 9.68 per cent (N=3), and then lastly School B, 3.33 per cent (N=1). Those who agreed with the view that the use of ICTs put more work on teachers were 29.79 per cent (N=28) of the total sample. School A had the largest percentage, 36.36 per cent (N=12), followed by School C, 29.03 per cent (N=9), and lastly School B which had 23.33 per cent (N=7) such respondents. Those who were uncertain were 28.72 per cent (N=27) of the total sample. School A had the largest percentage, 33.33 per cent (N=11), followed by School C, 29.03 per cent (N=9) and then School B, 23.33 per cent (N=7) of such respondents. 8.51 per cent (N=8) respondents strongly disagreed with the view that the use of ICTs put more work on teachers. The largest percentage of such respondents was at School B, 16.67 per cent (N=5), next School A, 6.06 per cent (N=2), and last School C which had the smallest percentage, 3.23 per cent (N=1) of such respondents. Respondents who disagreed were 23.40 per cent (N=22) of the total respondents. The largest percentage was at School B, 33.33 per cent (N=10), followed by School C, 29.03 per cent (N=9), and lastly School A with the smallest percentage, 9.09 per cent (N=3) of such respondents.

Respondents who strongly agreed that ICTs aroused learner curiosity in learning were 3.23 per cent (N=3) of all the respondents. School B had the largest percentage of such teachers, 3.33 per cent (N=1), followed by School C, 3.23 per cent (N=1), and then School A, 3.13 per cent (N=1). Those who agreed were 5.38 per cent (N=5) of the total sample. The largest percentage of such respondents was at School B, 10.00 per cent (N=3), then School C, 3.23 per cent (N=1) and lastly School A, 3.13 per cent (N=1) respondents. Respondents who were uncertain were 24.73 per cent (N=23) of the total sample. School A had the largest percentage 43.75 per cent (N=14), followed by School B, 16.67 per cent (N=5) and then School C with the smallest percentage, 12.90 per cent (N=4) of such respondents. Those who disagreed were 27.96 per cent (N=26) of the total sample. Most of them were School B respondents, 30.00 per cent (N=9), followed by School C, 29.03 per cent (N=9), and lastly School A which had the least percentage, 25.00 per cent (N=8).Some respondents, 38.71 per cent (N=36) of the total sample, strongly disagreed that ICTs aroused learner curiosity in the learning process. The majority of such respondents was at School C, 51.61 per cent (N=16), followed by School B, 40.00 per cent (N=12), and then School A with the fewest, 25.00 per cent (N=8) of such respondents.

Furthermore, only 2.13 per cent (N=2) of the total sample strongly agreed with the view that ICTs helped them in addressing varying needs of learners. School B had a larger percentage, 3.33 per cent (N=1), than School C, 3.23 per cent (N=1) of such respondents. There were no respondents who agreed that ICTs helped them in addressing varying learners' needs. Respondents who were uncertain were 22.34 per cent (N=21) of the total sample. School A had the largest percentage, 30.00 per cent (N=10), followed by School B, 26.67 per cent (N=8) and then School C which had the smallest percentage, 9.68 per cent (N=3) of the uncertain respondents. Those who disagreed were 37.27 per cent (N=35) of the total sample. School A had the largest percentage, 39.39 per cent (N=13) of such respondents, followed by School C, 38.71 per cent (N=12), and lastly School B, 33.33 per cent (N=10) respondents. Respondents who strongly disagreed with the view that ICTs helped them in addressing varying needs of learners were 38.30 per cent (N=36) of the total sample. School C had the largest percentage, 48.39 per cent (N=15) of such respondents, followed by School B, 36.67 per cent (N=11), and lastly School A, which had the smallest percentage, 30.30 per cent (N=10) of such respondents.

Respondents who strongly agreed with the view that the use of ICTs in teaching was enjoyable were 3.19 per cent (N=3) of the total sample. School C had more respondents, 6.45 per cent (N=2), than School A, 3.03 per cent (N=1) who strongly agreed to the view. A very few respondents disagreed that using ICTs in teaching was enjoyable. Only a School A respondent, 1.06 per cent (N=1) agreed with the view that the use of ICTs in teaching was enjoyable. Respondents who were uncertain were 14.89 per cent (N=14) of the total sample. Again, School A had the largest percentage of such teachers, 21.21 per cent (N=7), followed by School B, 20.00 per cent (N=6) and lastly School C which had the smallest percentage, 3.23 per cent (N=1) of such respondents. Those who disagreed were 36.17 per cent (N=34) of the total sample. School C had the largest percentage of such respondents, 45.16 per cent (N=14), followed by School B, 40.00 per cent (N=12), and lastly School A, 24.24 per cent (N=8). Some respondents, 44.68 per cent (N=42), strongly disagreed with the view that the use of ICTs in teaching was enjoyable. The largest percentage was from School A respondents, 48.48 per cent (N=16), followed by School C, 45.16 per cent (N=14), and School B had the smallest percentage, 40.00 per cent (N=12) of such respondents.

It can be further deduced, from data in Table 8.32, that some respondents strongly agreed that using ICTs in teaching was difficult. Those were 8.51 per cent (N=8) of the total sample. The largest percentage came from School C respondents, 9.68 per cent (N=3), followed by School A, 9.09 per cent (N=3), and lastly School B which had the smallest percentage, 6.67 per cent (N=2) of such respondents. Those who agreed were 42.55 per cent (N=40) of the total sample. School A had the largest percentage, 45.45 per cent (N=15), followed by School C, 45.16 per cent (N=14) and lastly School B with the smallest percentage, 36.67 per cent (N=11) of such respondents. The uncertain respondents were 27.66 per cent (N=12) of the total sample. School A had the largest percentage, 36.36 per cent (N=12), followed by School B, which had 23.33 per cent (N=7) such respondents, and lastly School C with 22.58 per cent (N=7). Those who disagreed were 15.96 per cent (N=15) of the total sample. The largest percentage was from School B respondents, 23.33 per cent (N=7), followed by School C, 22.58 per cent (N=7), and lastly School A, 3.03 per cent (N=1) such respondents. Respondents who strongly disagreed were 5.32 per cent (N=5) of the total sample. School B had a larger percentage of such respondents, 10.00 per cent (N=3), than School A, which had 6.06 per cent (N=2).

Data in Table 8.32 further reveals that 14.89 per cent (N=14) respondents strongly agreed that they were hesitant to use ICTs in teaching and learning. School B had the largest percentage, that is, 16.67 per cent (N=5) of such respondents, followed by School A, 15.15 per cent (N=5), and then School C, 12.90 per cent (N=4). Those who agreed to that view were 13.83 per cent (N=13) of the total sample. School B had the largest percentage of such respondents, 20.00 per cent (N=6), followed by School A, 12.12 per cent (N=4), and lastly School C, 9.68 per cent (N=3). Respondents who were uncertain were 17.02 per cent (N=15) of the total sample. School A had the largest percentage of such respondents, that is, 18.18 per cent (N=6), followed by School C, 16.13 per cent (N=5), and School B had the smallest percentage, 13.33 per cent (N=4) of hesitant respondents. Respondents who disagreed were 29.79 per cent (N=28) of the total sample. The largest percentage was at School A, 33.33 per cent (N=11), followed by School C, 32.26 per cent (N=10), and then School B, 23.33 per cent (N=7). Respondents who strongly disagreed that they were hesitant to use ICTs in teaching were 25.53 per cent (N=24) of the total sample. School C had the largest percentage of such teachers, 29.03 per cent (N=9), followed by School B, 26.67 per cent (N=8), and then School A which had the least percentage, 21.21 per cent (N=7) of such respondents.

Additionally, respondents who strongly agreed that they did not believe that the use of ICTs would benefit their teaching were 20.21 per cent (N=19) of the total sample. School C had the largest percentage, 22.58 per cent (N=7), followed by School A, 21.21 per cent (N=7), and lastly School B which had the smallest percentage, 16.67 per cent (N=5) of such respondents. Those who agreed were

11.70 per cent (N=11) of the total sample. School B had the largest percentage, 13.33 per cent (N=4), followed by School C, 12.90 per cent (N=4), and lastly School A, which had the smallest percentage, 9.09 per cent (N=3) of such respondents. The uncertain respondents were 23.40 per cent (N=22) of the total sample. School A had the largest percentage, 27.27 per cent (N=9), followed by School C, 25.81 per cent (N=8) and then School B, 16.67 per cent (N=5) of such respondents. Respondents who disagreed with the view that the use of ICTs would not benefit their teaching were 19.15 per cent (N=18) of the total sample. School B had the largest percentage of such respondents, 23.33 per cent (N=7), followed by School C, 19.35 per cent (N=6), and then School A, with the smallest percentage, 15.15 per cent (N=5) of such respondents. Those who strongly disagreed that using ICTs would not benefit their teaching were 25.53 per cent (N=24) of the total sample. The largest percentage of such respondents was from School B, 30.00 per cent (N=9), followed by School A, 27.27 per cent (N=9), and lastly School C, which had the smallest percentage, 19.35 per cent (N=6) of such respondents.

Table 8. 33: Mean scores for perceptions of the impact of ICTs in teaching and learning

	School A N=33		**School B N=30**		**School C N=31**		**Total N=94**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
ICTs are disruptive when teaching	3.27	1.15	2.67	1.24	3.10	1.04	3.02	1.16
ICTs make teaching effective	3.94	0.70	3.90	0.80	4.32	0.65	4.05	0.74
ICTs promote learner to learner interaction	3.94	0.70	3.90	0.71	4.26	0.68	4.03	0.71
ICTs help in improving learner performance	3.76	0.94	3.93	0.87	4.00	0.78	3.89	0.86
Use of ICTs in teaching and learning can improve learners' critical thinking	3.85	0.76	3.77	0.68	4.19	0.70	3.94	0.73

Knowing how to use ICTs by teachers is a good skill	4.55	0.71	4.13	0.78	4.45	0.62	4.38	0.72
Use of ICT tools in the classroom is beneficial in teaching and learning of my subject area	3.82	0.81	4.03	0.82	4.39	0.88	4.08	0.86
ICTs make lesson plans richer	4.00	0.83	4.17	0.99	4.32	0.75	4.16	0.86
ICTs help teachers save time during lesson preparation	3.70	0.85	3.93	1.02	3.94	1.12	3.85	0.99
Use of ICTs puts more work on teachers	3.45	1.06	2.63	1.13	3.19	0.98	3.11	1.10
ICTs arouse learner curiosity in the learning process	3.66	1.00	3.93	1.14	4.23	1.02	3.94	1.07
ICTs help me to address varying needs of learners	4.00	0.79	4.00	0.98	4.29	0.90	4.10	0.89
Use of ICTs in teaching is enjoyable	4.12	1.05	4.20	0.76	4.23	1.02	4.18	0.95
Using ICTs in teaching is difficult	3.48	0.94	3.07	1.14	3.42	0.96	3.33	1.02
I am hesitant to use ICTs in teaching and learning	2.67	1.36	2.77	1.48	2.45	1.36	2.63	1.39
I do not believe that the use of ICTs will benefit my teaching	2.82	1.49	2.63	1.47	3.00	1.44	2.82	1.46

Overall, two items out of 16 had mean scores below the scale midpoint of 2.82 (sd=1.46) and 2.63 (sd=1.39) respectively, indicating that teachers disagreed that using ICTs had an impact on teaching and learning. Seven items had mean scores ranging from 3.02 to 3.94, indicating that teachers moderately agreed that using ICTs impacted teaching and learning in a positive way. Also seven items had mean scores which ranged from 4.03 to 4.38, indicating that teachers agreed that using ICTs in the classroom highly impacted teaching and learning.

Hesitance to use ICTs in teaching and disbelief that using ICTs would benefit teaching had mean scores ranging from 2.63 to 2.82, indicating that teachers disagreed that that they hesitated using the technology and that they did not believe that ICTs benefitted their teaching. It was only School C which had a mean score at midpoint 3, indicating that teachers moderately agreed that they did not believe that using ICTs would benefit their teaching.

The following items: ICTs are disruptive when teaching, ICTs help in improving learner performance, use of ICTs in teaching and learning can improve learners' critical thinking, use of ICTs puts more work on teachers, ICTs arouse learner curiosity in the learning process, and using ICTs in teaching is difficult, had mean scores ranging from 3.02 to 3.94, indicating that teachers moderately agreed with those views. It was only School B that had a mean score below midpoint 3 but above 2, for the item ICTs are disruptive when teaching, indicating that teachers disagreed with that view. Teachers at School C agreed that ICTs helped in improving learner performance and also agreed that the use of ICTs in teaching could improve learners' critical thinking, as indicated by high mean scores of 4.00 and 4.19, respectively. The other two schools moderately agreed with those views. It was only School B teachers who disagreed that ICTs put more work on them, as indicated by a mean score of 2.63 (sd=1.39). The other two schools moderately agreed with that ICTs put more work on them. Again, it was School C that had mean scores at point 4 and above 4, but below 5 on items, ICTs arouse learners' curiosity, ICTs help in improving learner performance and ICTs in teaching could improve learners' critical thinking, indicating that that teachers agreed that those views positively impacted teaching and learning.

Seven items had mean scores ranging from 4.03 to 4.38. These items are: ICTs make teaching effective, ICTs promote learner to learner interaction, knowing how to use ICTs is a good skill, the use of ICT tools in the classroom is beneficial in teaching and learning of my subject areas, ICTs made lesson plans richer, and ICTs help to address varying needs of learners.

School C had mean scores above 4 but below 5 for both items, ICTs make teaching effective and ICTs promote learner to learner interaction, indicating that teachers agreed that ICTs positively impacted on teaching and learning. Schools A and B had mean scores above midpoint 3 but below 4, an indication that teachers moderately agreed with the views. Again, School C had the highest mean score above 4 but below 5 for the item, the use of ICT tools in the classroom is beneficial in teaching and learning of my subject areas, indicating that teachers agreed with that view. It was only School A teachers who moderately agreed that using ICTs in the classroom was beneficial, indicated by a mean score above midpoint 3 but below 4.

Teachers at all the three schools were positive about the use of ICTs, as indicated by a high total mean score of 4.38 (sd=0.72). Each school had a mean score that was above 4 but below 5, indicating that teachers at the three schools agreed that knowing how to use ICTs was a good skill. Other items that had total means above 4 but below 5 per school were, ICTs make lesson plans richer, ICTs helped them to address varying needs of learners, and that the use of ICTs in teaching is enjoyable. Thus, teachers were positive about using ICTs in teaching and learning.

8.16.1 Opinions and attitudes towards the integration of ICTs in teaching

As discussed in the previous section, Question B5 deals with attitudes and opinions regarding the integration of ICTs in teaching and learning. A principal factor analysis with varimax rotation was conducted. Only factor loadings of 0.4 or above were taken into account. Initially three factors were extracted. However, as it was difficult to interpret the third factor theoretically, a second analysis was conducted to extract only two factors. The rotated factor matrix is reported in Table 8.34.

Table 8. 34: Results of factor analysis for items pertaining to attitudes and perceptions regarding the use of ICTs in teaching and learning

	Component	
	1	2
B5.2 ICTs adoption - ICTs make teaching effective	.838	
B5.3 ICTs adoption - ICTs promote learner to learner interaction	.856	
B5.4 ICTs adoption - ICTs help in improving learner performance	.694	
B5.5 ICTs adoption - Use of ICTs in teaching and learning can improve learners' critical thinking	.841	
B5.6 ICTs adoption - Knowing how to use ICTs by teachers is a good skill	.685	
B5.7 ICTs adoption - Use of ICT tools in the classroom is beneficial in teaching and learning of my subject area	.789	
B5.8 ICTs adoption - ICTs make lesson plans richer	.834	
B5.9 ICTs adoption - ICTs help teachers save time during lesson preparation	.622	
B5.11 ICTs adoption - ICTs arouse learner curiosity in the learning process	.720	
B5.12 ICTs adoption - ICTs help me to address varying needs of learners	.840	
B5.13 ICTs adoption - Use of ICTs in teaching is enjoyable	.566	
B5.14 ICTs adoption - Using ICTs in teaching is difficult [R]		-.869
B5.15 ICTs adoption - I am hesitant to use ICTs in teaching and learning [R]		.952
B5.16 ICTs adoption - I do not believe that the use of ICTs will benefit my teaching [R]		.930
B5.1 ICTs adoption - ICTs are disruptive when teaching		

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was a satisfactory 0.855, indicating that a problem with multi-collinearity is unlikely. The first factor explained 42.81% of the variance and the second factor 17.87%. The total variance explained by these two factors was 60.684%.

Composite measures were, consequently, compiled for the two factors. The first factor – Positive Attitudes towards ICT Integration − included the 11 items with loadings of 0.4 or above on Factor 1. Scores could vary between 5 and 55, and a higher score was indicative of more positive attitudes. The Cronbach alpha was .919.The second factor – Doubt and Hesitancy regarding ICT Integration – was compiled of the three items with factor loadings of 0.4 or more on Factor 2. The Cronbach alpha of -.235 for this factor was, however, unsatisfactory. As inter-item correlations did not indicate a particular item to be the problem, it was not possible to improve the Cronbach alpha. This measure was, consequently, not investigated any further and not used in further analysis.

Table 8. 35: Mean scores for teachers' Attitudes towards ICT Integration

School	Mean	Std. Deviation	N
A	43.19	6.669	32
B	43.69	7.344	29
C	46.61	6.984	31
Total	44.50	7.083	92

The mean scores for Factor 1 are given in Table 8.35. The means for all three schools were relatively high, indicating positive attitudes towards ICT integration. Although the mean score for School C is notably higher than for the other two schools, a one-way analysis of variance (ANOVA) indicates no statistically significant differences between the three schools ($F(2,93)=2.173$; $p=.120$;eta=.047).

A univariate analysis of variance (ANOVA) was further conducted to investigate differences with regard to gender, age, highest educational qualifications and years of experience. The final model, however, indicated no statistical differences for any of these variables ($F(26, 89) =1.030$; $p=.446$; eta=.298).

8.17.2: Correlations between various composite scales

Table 8. 36: Correlations between composite scales

		ICT skills	Basic ICT Integration	Advanced ICT integration	Positive attitudes towards ICT integration	Sufficient Training and Confidence	Support-related Barriers	Attitudinal Barriers
ICT skills	Pearson Correlation	1	.639**	.352**	.436**	.502**	-.065	-.158
	Sig. (2-tailed)		.000	.000	.000	.000	.533	.129
	N	94	92	94	92	94	94	94
Basic ICT Integration	Pearson Correlation	.639**	1	.541**	.426**	.647**	-.228*	-.245*
	Sig. (2-tailed)	.000		.000	.000	.000	.029	.019
	N	92	92	92	90	92	92	92
Advanced ICT integration	Pearson Correlation	.352**	.541**	1	.090	.404**	-.056	.079
	Sig. (2-tailed)	.000	.000		.392	.000	.595	.450
	N	94	92	94	92	94	94	94
Positive attitudes towards ICT integration	Pearson Correlation	.436**	.426**	.090	1	.474**	-.152	-.113
	Sig. (2-tailed)	.000	.000	.392		.000	.148	.285
	N	92	90	92	92	92	92	92
Sufficient Training and Confidence	Pearson Correlation	.502**	.647**	.404**	.474**	1	-.534**	-.500**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	94	92	94	92	94	94	94
Support-related Barriers	Pearson Correlation	-.065	-.228*	-.056	-.152	-.534**	1	.799**
	Sig. (2-tailed)	.533	.029	.595	.148	.000		.000
	N	94	92	94	92	94	94	94

Attitudinal Barriers	Pearson Correlation	-.158	-.245*	.079	-.113	-.500**	.799**	1
	Sig. (2-tailed)	.129	.019	.450	.285	.000	.000	
	N	94	92	94	92	94	94	94

p<.05
**p<.01
Cohen's d values – Cohen suggested that d=0.2 be considered a 'small' **effect size**, 0.5 represents a 'medium' **effect size** and 0.8 a 'large' **effect size**

Correlation analysis was conducted to determine the relationships between the various composite scales. The largest correlation was found between support-related and attitudinal barriers (r=.799; p<.01**). If rounded off, this correlation could be regarded as a large effect according to Cohen's d-values. This correlation points to the fact that a lack of infrastructure and support was strongly correlated with attitudinal barriers (that is, negative attitudes towards ICTs in teaching and learning).

The second highest correlation was between Confidence and Basic ICT Integration, indicating that sufficient training and confidence were positively related to ICT integration on a basic level (r=.647; p<.01**).

The third highest correlation was between Basic ICT Integration and ICT skills (r=.639; p<.01**). Better ICT skills were, consequently, positively related to ICT integration on a basic level.

Furthermore, there was a negative correlation between Basic ICT Integration towards Attitudinal barriers (r=-.245*) and Support-related barriers (r=-.228*). The negative coefficients imply that the experience of attitudinal and support-related barriers correlated with less basic ICT integration.

ICT skills were on the other hand positively correlated to both Advanced ICT Integration (r=.352; p<.01**) and Positive Attitudes towards ICT Integration (r=.436; p<.01**). Better ICT skills were, consequently, positively related to Advanced ICT integration and Positive attitudes towards ICT integration.

There was also a positive correlation between ICT skills and sufficient training and confidence (r=0.502; p<.01**). This correlation implies that better ICT skills were positively related with sufficient training and confidence.

There was also a positive correlation between Basic ICT integration and Advanced ICT integration (r= 0.541; p<.01**). This correlation (r=0.541; p<.01**) implies that integrating ICT at basic level positively related to integration of ICT at advanced level.

The correlations discussed in the previous paragraphs can all be regarded as medium effects according to Cohen's d values. A number of smaller effects were also found. Basic ICT integration was also correlated positively with Positive Attitudes towards ICT Integration (r=.426; p<.01).

There was also a positive correlation between Advanced ICT Integration and Sufficient Training, and Confidence (r=0.404; p<.01**). The correlation (r=0.404; p<.01**) can also be regarded as a small effect and indicates that the Advanced ICT Integration was positively related to sufficient training and confidence.

There was a further positive correlation between Positive Attitudes towards ICT Integration and Sufficient Training and Confidence (r=0.474; p<.01**). The correlation (r=0.474; p<.01**), if rounded off can however be regarded as medium effect and points to the fact that positive attitudes towards ICT integration related positively to sufficient training and confidence.

Basic ICT integration and Sufficient Training and Confidence related negatively with Infrastructure and Support-related (r=-.228; p<.05), as well as with Attitudinal Barriers (r=-.245; p<.05). These correlations imply that these barriers had a negative relationship with the integration of ICTs and the confidence to do so.

8.17.3 Multiple linear regression analysis

Table 8. 37: Multiple linear regression analysis of basic ICT integration

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-3.199	3.286		-.974	.333
ICT skills	.331	.092	.313	3.580	.001
Advanced ICT integration	.841	.205	.343	4.109	.000
Positive attitudes towards ICT integration	.098	.066	.123	1.468	.146
Sufficient Training and Confidence	.177	.078	.253	2.269	.026
Support-related Barriers	.040	.078	.062	.514	.609
Attitudinal Barriers	-.126	.130	-.116	-.964	.338

a. Dependent Variable: Basic ICT Integration

Multiple linear regression analysis was furthermore conducted to investigate the predictors of ICT integration on a basic level. The dependent variable was Basic ICT Integration and the following independent variables were included in the model: ICT Skills, Advanced ICT Integration, Positive Attitudes towards ICT Integration, Sufficient Training and Confidence, Infrastructure and Support-related Barriers and Attitudinal Barriers. The results are reported in Table 8.38. The model explained 62.0% of the variance.

Three variables were significant predictors of Basic ICT Integration: ICT skills (p=.001), Advanced ICT Integration (p=.000) and Sufficient Training and Confidence (p=.026). According to the standardised coefficients, Advanced ICT Integration was the strongest predictor and ICT skills the second strongest. Thus, the ability to integrate advanced ICT software in teaching and learning also correlated positively with the integration of ICTs on a basic level. More advanced skills, furthermore, correlated with more integration of ICTs on a basic level. Similarly, sufficient training and the concomitant confidence to use ICTs was also a positive predictor of ICT integration on a basic level. It is further interesting to note that none of the barriers to ICT integration (infrastructure and support-related as well as attitudinal) were significant predictors of ICT integration in this model.

8.17 Conclusion

This chapter presented data and statistics on respondents' views on the adoption and use of ICTs at schools. In terms of availability of ICTs at schools, respondents acknowledge the availability of ICTs, though inadequate. As far as the extent to which the respondents were ready to use ICTs in teaching, the majority of them were faced with ICT infrastructure challenges, limited ICT skills, inadequate support from the government and school management, among others. Some respondents used ICTs in teaching and learning. However, they differed at the level of integration due to differences in ICT skills. ICT support programmes were available to some respondents. Respondents needed more ICT support. It can, therefore, be concluded that some respondents at the three schools in this study adopted and were using ICTs in teaching and learning. However, there were several barriers that hindered respondents from fully utilising the technologies in the classroom. The following chapter is a discussion of both qualitative and quantitative findings. Conclusion are also made in the same chapter.

CHAPTER 9

CONCLUSIONS

9.1 Introduction

This study reviewed literature and mainly focused on the information society, the digital divide and technological pedagogical content knowledge (TPACK). A presentation of qualitative and quantitative data studies, as well as data analysis, was also done. This chapter integrates the results of both qualitative and quantitative studies with current theorising and discourses as reflected in the literature review. This chapter, therefore, focuses on how this study confirms, diverges or adds to existing literature, by exploring the adoption and use of ICTs at township secondary schools in South Africa. Findings of this study are discussed in terms of the research questions.

9.2 Material access

Material access is one of the various forms of access related to the digital divide (Van Dijk 1999). Thus the first sub-research objective of this study sought identify technologies available for teaching and learning. The teachers in this study accessed some ICTs at home and at school. Material access at schools was affected by factors such as theft, vandalism, a limited supply of electricity, as well as a lack of a school-based ICT technician.

9.2.1 ICTs that teachers accessed at home

It emerged, from this study, that the "material divide" existed among teachers (Van Deursen & Van Dijk 2019: 357). The teachers accessed different types and amounts of ICTs at home. Most teachers had access to a smartphone and a computer, a few owned a tablet and an internet connection at home. However, some teachers had no access at all to some ICTs such as a tablet, the internet and a smartphone, for example, more than 50 per cent of teachers at Schools A and B had no access at all to the internet at home. Therefore, there was unequal access to ICTs among teachers and this creates a digital divide in society.

Teachers with access to a variety of devices have more opportunities to, for instance, financial inclusion and civic participation, compared to those with limited device access. This is validated by the argument that differences in the amount of information individuals access, creates inequality in society, at national, regional and global levels (Fuchs & Horak 2008; Van Dijk 2012). Furthermore, differences in the amounts of ICTs that teachers accessed at home might be a reflection of skills disparities, as material access also includes the degree to which ICTs can be used by individuals (Van Dijk 2008).

9.2.2 ICTs available for teaching and learning

Inclusion and exclusion are digital divide dynamics which articulate the levels of ICTs resources that individuals have access to (van Dijk 2017). In response to the first sub-research objective on identifying technologies available for teaching and learning, two issues were raised by teachers, namely the availability and accessibility of ICTs for teaching and learning. Teachers revealed that ICTs such as smart boards and laptops were available to only a few teachers, and tablets to some learners. Inadequate ICT infrastructure and ICT availability were, thus, a challenge at the schools studied. For example, the majority of teachers had no access to a smart board at all (see Table 8.6). Mean scores as high as 40.55, for example for School C, were recorded for challenges regarding the use of ICTs such as infrastructure-related challenges (see section 8.16.1). These findings were contrary to the Gauteng MEC, Mr Panyaza Lesufi's argument that the future of education lies in technology (Makhubu 2014). Inequitable distribution of ICTs at schools, thus, thwarted the commitment made by world leaders at the 2007 WSIS to "turn the digital divide into a digital opportunity for all" (Bagula, Zennaro, Nungu & Nkoloma 2011). Rather, the existence of the digital divide was deepening instead of closing at the schools. These findings were surprising to me, since the Department of Education official helped me to select schools that had ICT infrastructure for teaching and learning. I expected to find functioning smart boards, equipped ICT laboratories, tablets and internet access at the schools. This is a clear indication that there is a need for the Department of Education officials to make a follow on the ICTs rolled-out at schools.

Furthermore, the physical access gap at the schools was perpetuated by the unequal distribution of ICT infrastructure. The availability of limited ICTs to a few Grade Eleven and Twelve teachers indicated that a physical access divide was widening and deepening (Van Dijk 2005). It was established that some teachers were using smart boards connected to the internet. Such teachers had access to information which could not be accessed by other teachers. This gives rise to the “information-haves and information-have-nots” (Bornman 2016). The scenarios at the schools indicated that the paperless classroom was still far from being reached. It can also be argued that limited access to, and use of ICTs indicates that the schools are not part of the information society. Elements forming the foundation of an information society include an increase of ICTs, and access to, and use of ICTs (Zachery 2009; Al-Nasrawi & Zoughbi 2015). This was not the case at the schools in this study.

My visits to ICT laboratories further revealed the inadequacy of ICT infrastructure at the schools. Some of the ICT laboratories were empty due to theft, others had computers which were not functioning and were disconnected from the internet. Theft of ICTs thwarted the aim of the Gauteng online project on the use of computers which are connected to unlimited internet connection. At one of the schools it was established that some computers had been put away in a safe place to avoid theft. Thus, they could not be accessed by teachers and learners. This confirms Chikasa, Ntuli and Sunderjee’s (2014) finding that computer laboratories were not used for teaching and learning purposes in most schools in Johannesburg. In some cases, it emerged from the interviews that the Department of Education (DoE) had disconnected the Gauteng online laboratory. This was in contradiction to the Gauteng Member of the Executive Council (MEC), Mr Panyaza Lesufi’s argument that bringing ICTs to schools in Gauteng Province meant that the province takes lead in improving the education system in the country (Makhubu 2014).

The internet was another ICT infrastructure that was available at schools, but could not be accessed for teaching and learning by most teachers. Access to the internet at the schools fell short of all the characteristics of Ndukwe’s (2010) summary of what entails internet access (cited in Tomei 2012). Slow and sometimes unavailable internet was confined to the administration blocks of the schools and only one smart board at School B which had a router. It emerged, from the teachers that the unavailability of the internet was a challenge, because they could not conduct research online. The unavailability of the internet might lead to a further “widening of knowledge gap and deepening” of prevailing social and economic disparities among the developed and developing nations (Mikre 2011:2). From a technological perspective, it can be posited that the schools were only partially part of the information society since internet connection was confined to the administration block. The rest of the school premises were disconnected from the internet which provides information at any given point of time and at any location. It can be argued that a limited internet access at the schools thwarted the aim of the e-learning policy in South Africa to connect learners and teachers through ICT networks to one another as well as to experts in various subjects (South Africa: Department of Education Government Gazette Draft 2004).

9.2.3 A lack of educational software

Furthermore, providing teachers with ICTs but limited educational software is detrimental to using the technologies in teaching and learning (Ghavifekr, Kunjappan, Ramasamy & Anthony 2016). It emerged, from the focus group discussions, that educational software was limited to e-books, teachers’ guides and past examination papers. The teachers also revealed that there was only one e-book installed on smart boards per subject. The teachers were, thus, relying solely on one source of information when teaching learners. Thus, 77.66 per cent of the respondents rated a lack of educational software an important to a very high important barrier to the use of ICTs in teaching (see Table 8.27). One unanticipated finding that was also established, in the qualitative discussions, was that, there was no educational software for home languages such as Sesotho and IsiZulu. Home language teachers had no other choice except to teach using hard copy textbooks. A similar finding was obtained at some Irish schools, where there was a limited availability of Irish-language resources on tablets (Young

2016). Some teachers in the current study revealed that many of the e-books that were installed on smart boards and tablets were also irrelevant to their particular subjects. Also, they had to fall back on hard copy textbooks. It was also established that the educational software that was installed on smart boards did not link with what was installed on learners' tablets and on some teachers' laptops from the DoE. Therefore, it was difficult to use ICTs in teaching.

9.2.4 Limited access to high speed internet

Access to high speed internet is regarded as a necessity at schools (Fox & Jones 2019). Teachers and learners need the internet to do research, to connect with peers and to prepare for their lessons, among other things. Webster's (2006) spatial definition of an information society emphasises information networks that connect people and places in different geographical locations. It, however, emerged from qualitative interviews that there was limited internet access at all the schools (see sections 7.2.2 & 7.3.2).

Research ICT Africa (2017) posits that 75 per cent of Africa is disconnected from the internet. Furthermore, it is argued that the "new" digital divide is not only ascribed to the absence of infrastructure or connections but, in its current form, is shifting from "basic to advanced communications and from quantity to quality" (ITU 2002:2). The findings of this current study confirmed these tendencies. The majority of the teachers, over 70 per cent, responded that limited access to high speed internet was an important barrier to the adoption and use of ICTs in teaching (see Table 8.27). It was further gathered, through qualitative interviewees, that internet access was only available at the school administration blocks. Smart boards were disconnected from the internet due to theft of the internet routers. The Gauteng online ICT laboratories were also offline. Teachers were only relying on hard copy text books and the installed e-books on smart boards due to a lack of internet access. They could, therefore, not connect with peers on portals such as Thutong Portal (see section 4.8.3). These findings confirm Castells' (2003: 247) view that the centrality of ICT, including the internet, can be said to be “tantamount to marginality for those without, or with only limited, access to the Internet, as well as of those unable to use it effectively.”

9.2.5 Limited supply of electricity

Electricity is a prerequisite for ICTs to function (Omotayo 2016). Both the qualitative and quantitative studies revealed that there was an irregular supply of electricity to the schools. The majority of teachers, almost 90 per cent, rated a limited supply of electricity important to very high important a barrier to the use of ICTs. It was also established, through the qualitative interviews, that all the schools experienced a lot of power cuts during winter. The interviewees explained that the schools are situated in poor townships where some people are illegally connected to electricity supply hence the power cuts. Electricity cables were also stolen at some schools, so some smart boards were disconnected from the power supply, thus could not be used during teaching and learning. This finding confirmed findings at a junior secondary school in Cofimvaba in the Chris Hani District Municipality, where there were constant power cuts (Steyn & Greunen 2014). A consequence of the irregular supply of electricity was that some teachers abandoned e-learning.

9.2.6 A lack of a school-based ICT technician

Participants in the qualitative study as well as respondents in the questionnaire survey concurred that a lack of school-based ICT technicians was a challenge to the adoption and use of ICTs in teaching and learning. In this study, it was established that ICT technicians would take ages to come or did not come at all to schools when requested to do so. This was evidenced at one of the schools. There was only one smart board working when I first visited the school and that smart board had stopped working on my second visit. The unavailability of technical support resulted in teachers abandoning ICTs and resorting back to traditional methods of teaching. This finding concurs with Law, Pelgrum and Plomp’s (2008), and Ogunniyi’s (2016) findings that many teachers in South Africa complained about a lack of a school-based technician. Favourable ICT-related school conditions, such as an ICT coordinator who assists teachers with technical support and relevant pedagogics can, consequently, be regarded as a necessity for the adoption and use of ICTs (Rodríguez-Miranda, Pozuelos-Estrada & León-Jariego 2014).

9.2.7 Theft and vandalism of ICT infrastructure

Theft was another barrier to the successful implementation of ICTs in teaching and learning (Ngqakamba 2019). It was established, through the qualitative interviews, that most smart boards were disconnected from the internet since routers were stolen. At one school, even electricity cables were stolen from classrooms, hence smart boards were disconnected from the power supply. Furthermore, computers were stolen from ICT laboratories and computer lessons had to be abandoned. These findings concur with the findings of other studies. The study by Els and Blignaut (2010) revealed that at Sibiya High School in Rustenburg in the North West Province of South Africa, ICTs were stolen.

Teachers also stated that learners were victims of theft; they were robbed of tablets in the community. The schools in this study were all situated in poverty stricken communities where theft was high. Furthermore, some teachers explained that some parents took tablets given to learners at school and used the tablets to pay their debts at *kwamatshonisa* (money launderers). This could be due to the fact that some parents still believed in the traditional model of education and did not understand the importance of using technology in education (Zaka 2013).

It can be stated that teachers experienced similar barriers to the adoption and use of ICTs in teaching and learning. The schools were in the same township and experienced a similar ICT ecology. There were few differences between the three schools. Only in the case of infrastructure and support-related barriers as well as attitudinal barriers were School C significantly worse off than the other two schools (see section 8.16.1).

9.3 Teacher readiness to use the identified technologies in the classroom

Factors identified in the literature which affect teacher readiness to use the available ICTs at schools include attitudes and digital skills (Chigona & Chigona 2010; Agbo 2015). In this study, the second research objective sought to investigate teacher readiness to use the available technologies in the classroom. This is addressed in this section, including demographic variables.

9.3.1 Demographic variables

In this study, demographic variables were significantly related to ICT skills. The skills of younger teachers with less years of experience were found to be significantly better than those of older teachers with more experience. A tendency was observed that teachers with higher educational qualifications (such as a postgraduate degree) integrated ICTs on a more advanced level. This tendency was, however, not statistically significant on the 0.05-level. However, as advanced ICT integration was the most important predictor of basic ICT integration, it does appear that enhancing the qualifications of teachers could foster higher degrees of integrating ICT in teaching and learning. That could also be true of older and more experienced teachers who have not grown up with ICTs, unlike the younger generation.

It was also deduced, from the quantitative data, that some teachers were hesitant to use ICTs in teaching and learning, for example, almost a third of the teachers agreed that they hesitated using the technologies in the classroom (see Table 8.32). It was also revealed, in the qualitative interviews, that some teachers believed that they were too old to learn how to use ICTs in teaching and learning. A teacher argued that he had been in the teaching profession for 25 years when ICTs were introduced at schools, so he was too old and hesitant to learn ICT skills (section 7.3.2). This finding confirms Van Dijk's (2012) argument that computer anxiety and technophobia are impediments to computer and internet access among the older persons.

The older teachers further argued that the young teachers could adopt and use ICTs in the classroom while the older teachers could continue teaching using traditional methodologies. These findings concur with those of Jang and Tsai's (2013) Taiwanese study, which explored competencies regarding the TPACK framework of secondary school science teachers and revealed that experienced teachers were less confident in ICT knowledge. The less experienced Taiwanese teachers rated their technological content knowledge higher than the experienced teachers. In the current study, some teachers and a school principal also argued that teachers who recently graduated from colleges/universities had digital skills and were using ICTs in teaching and learning. The senior teachers might not have been trained in ICT skills at colleges/universities so they had inadequate skills. The findings of both the Taiwanese and the current study refute Chigona's (2015) finding that most of the newly qualified teachers in South Africa were not able to teach using the new technologies. The influence of demographic variables was, however, limited. There are, therefore, other factors such as skills that could have played a role.

9.3.2 Limited ICT skills among teachers

After an individual has acquired motivation to use ICTs and has physical access to the infrastructure, the individual has to learn to effectively and efficiently use the ICTs (Ghavifekr & Rosdy 2015). The literature, however, revealed that the problem of ICT skills such as multimedia literacy and computer skills might play a role in creating a digital divide (Van Dijk 1999; Chetty, Aneja, Mishra, Gcora & Josie 2018). Findings for this study confirm Van Dijk's argument. It emerged, from this study, that not all teachers were trained on how to use ICTs in the classroom since training mainly focused on Grade Ten to Twelve teachers. Those who were taken through training lamented the inadequacy of the training. Hence, most teachers rated themselves low on some ICT skills. For instance, less than ten per cent of the teachers confirmed that they had excellent statistical tools and Spreadsheets use skills (see Table 8.7). Such teachers could not effectively and efficiently use of ICTs in teaching and learning since they had insufficient technology knowledge (TK). However, some teachers, 89.36 per cent, had fair to excellent ICT skills, for instance in word processing. It is also important to note that technology knowledge (TK) goes beyond computer literacy.

To further reveal the limited digital skills among the teachers, about a third of the respondents agreed that they were not at all able to select ICTs that enhanced the content that they were teaching (see Table 8.20). Thus, those teachers lacked technological content knowledge (TCK) (Jaipal & Figg 2010). However, approximately 20 per cent of the teachers agreed to a large extent that they had the skills to select ICTs that enhanced the content that they were teaching. Having limited technological content knowledge (TCK) might have adverse effects on learning outcomes. The adoption and use of ICTs requires an individual who is capable of using the technologies in teaching and learning. It is, thus, necessary to equip teachers with ICT skills (Semerci & Aydin 2018).

A school principal explained that some teachers who were not trained how to use ICTs in teaching were allocated classes that had the ICT infrastructure. Hence the quantitative findings revealed that almost 50 per cent of the teachers responded that limited ICT skills were a very high important barrier to the use of ICTs in teaching (see Table 8.27). The majority of the participants admitted facing ICT skills challenges when using smart boards. They, thus, relied on learners whenever they failed to operate a smart board. Hence most of the teachers in this study rated limited ICT skills among learners as a less important to unimportant at all barrier to the use of ICTs in teaching.

Another unanticipated finding was that the facilitators ended up doing tasks that were meant to be done by the teachers. Thus, some teachers did not practically learn the ICT skills, but merely observed some facilitators doing the tasks on their behalf. Thus, the teachers lacked practical teaching competency, which is technology pedagogical knowledge (TPK) (Jaipal & Figg 2010). Teachers explained that the ICT facilitators experienced pressure to conduct teacher training in three days. This finding concurred with Olakulehin’s (2007) finding on a study of ICT teacher training in Nigeria. Olakulehin identified a lack of practical exposure to ICTs as a hindrance to ICT integration in the classroom. In this study, the teachers also revealed that they were trained in a large number of skills at the same time and ended up not understanding almost everything. This finding suggests that there is a need for the Department of Education officials to evaluate the training that teachers are afforded and also the implementation of ICTs in teaching and learning needs to be evaluated.

Ziphorah's (2014) study revealed that ICT training did not assist teachers in learning content specific ways of integrating technology. Similar findings were obtained in this study. The quantitative responses revealed that about a quarter of the teachers were not at all trained on the appropriate ICTs that they could use in teaching their various subjects (see Table 8.22). Therefore, such teachers lacked technology content knowledge (TCK) competencies, that is, the ability to know ICTs which suit certain subject content (Koehler & Mishra 2008). Furthermore, the qualitative findings further revealed that teachers were all trained once, regardless of differences in ICT skills levels, yet Koehler and Mishra (2013) argued that there is no "one size fits all". Teachers teach different subjects and need to be trained on how to teach particular subject content using ICTs. Thus, the teachers - especially those with limited digital skills - wanted separate training from teachers who were already acquainted with ICTs.

Drawing from the multiple linear regression analysis (Table 8.37), ICT skills were one of the most important predictors in ICT integration. As ICT skills were the second strongest predictor, it appears that skills (also skills to use higher order software) were one of the most important factors that could determine the use of ICTs in teaching a learning.

9.3.3 A lack of confidence to use ICTs in teaching

A lack of confidence to use ICTs in teaching is associated with fear and anxiety when an individual is faced with technology (Van Dijk 2008). Slightly above a quarter of the respondents rated a lack of confidence an important barrier to the use of ICTs (see Table 8.27). It also emerged, from the interviews, that some teachers were not using ICTs due to a fear of the technology. This could be an indication of a lack of TPACK, which is describes what teachers must know in order to effectively integrate ICTs in teaching and learning (Koehler & Mishra 2008). A school principal observed that some teachers were technophobic, so they avoided using the ICTs in teaching and learning. This finding concurred with the viewpoint of Van Dijk (2008:28) that mental factors such as technophobia and computer anxiety explain “the rise and fall of motivation” to access technology. The teachers explained that the learners thought that they knew everything, so they laughed at teachers whenever they made mistakes when using smart boards. That caused teachers to lose confidence and to fear using ICTs in the classroom. This finding concurred with that of a study conducted at disadvantaged high schools under the Khanya Project in Cape Town, which revealed that some teachers feared making mistakes in front of students when using ICTs and resisted using the technologies during teaching and learning (Chigona et al 2010). Thus, it is argued that teachers who were not confident were reluctant to use ICTs in the classroom (Semerci & Aydın 2018).

9.3.4 A lack of motivation to use ICTs in the classroom

In this study, the majority of the respondents indicated that a lack of motivation was an important to a very high important barrier to the use of ICTs in teaching and learning (see Table 8.27). Deducing from the calculated mean scores, the majority of the lowly motivated were School C teachers (see Table 8.28). This could be due to the fact that only a few teachers had access to ICTs for teaching. The qualitative interviews revealed that inadequate and malfunctioning ICT infrastructure demotivated the teachers from adopting and using ICTs. This finding echoed Steyn and Van Greunen’s (2014) argument that inadequate ICT infrastructure could hinder the adoption and use of ICTs at some schools.

9.3.5 A lack of time

It was revealed, in both the qualitative and quantitative studies, that a lack of time was a further barrier to the use of technologies in the classroom. This confirms Ertmer’s (1999) argument that a lack of time is a first order barrier to the adoption and use of ICTs in teaching and learning. For instance, the majority of the teachers disagreed that ICTs helped them save time during lesson preparation (see Table 8.32). Some interviewees stated that preparing to teach using ICTs took a lot of their time, for instance, PowerPoint presentations. This was unlike the textbook which was readily available. They mentioned that teachers were involved in other teaching and learning duties, such as marking. This concurred with findings obtained at some Chinese secondary schools in Malaysia (Raman & Yamat 2014) and also at some public schools in Bartin city, Turkey (Özdemir 2017). Raman and Yamat argued that teachers were overburdened with administrative duties, hence did not have the time to prepare and use ICTs in their lessons. Some teachers in the current study argued that it was better to continue teaching using traditional methods than using ICTs. This, however, contradicted with findings from some teachers who argued that the use of smart boards saved time; the syllabus could be covered faster than when teaching using traditional methods.

9.3.6 Teachers' attitudes towards the use of computers in teaching and learning

The adoption and use of ICTs in teaching and learning is also affected by teachers' attitudes (Maksimovic & Dimic 2016). It is posited that people's attitudes toward technology can vary from positive to negative, depending on different factors that may influence these attitudes (Mustafina 2016). Teachers with negative computer attitudes are most likely less skilled in computer use and are, therefore, less likely to adopt and use ICTs in teaching than those with positive computer attitudes (Agbo 2015; Gyamfi 2017). It is, however, believed that negative attitudes towards ICTs can be changed to positive attitudes by providing teachers with adequate technologies (Ng & Nicholas 2013:714) and also motivating them to use ICTs (Yuen, Law & Wong 2003). It emerged, from the qualitative interviews, that some teachers were positive about the adoption and use of ICTs in the classroom. They, however, lacked ICT skills and adequate ICT infrastructure. These findings confirm Law and Chow's (2008) findings in a study conducted in the EThekwini municipality in KwaZulu-Natal. Law and Chow found out that teachers were positive about the uses of technology, but they lacked the necessary skills to adopt and use the technology in teaching and learning.

Confirming Law and Chow's findings and the qualitative findings for this current study are the results of the regression analysis (see Table 8.37). ICT skills were the second most important predictor of ICT integration in teaching and learning.

9.4 ICT support programmes available for the teachers

ICT support programmes for teachers are of importance in enhancing the adoption and use of ICTs in teaching and learning (Ghavifekr et al 2016). Thus data were solicited on support programmes available for teachers in order to establish factors that influence integration of ICTs in teaching and learning. This addressed the third sub-research objective of this study. In this study, such support programmes refer to professional development courses, ICT seminars and ICT support personnel. Findings from the quantitative and qualitative studies revealed that such support programmes were important to teachers.

9.4.1 ICT support personnel

Discussions with teachers and school principals revealed that ICT technicians were previously based at schools and offered ICT skills development training to teachers. The teachers explained that these courses did not only improve digital skills, but they also implemented the skills they acquired in teaching and learning. However, what is surprising is that, by the time that this study was conducted, ICT technicians were no longer at schools, but were based at the District Department of Education. This finding was unexpected and it suggests that the Education officials did not assess the needs of teachers with regards to ICT implementation.

Czernowalow (2015) holds that if e-learning is implemented, an information technology (IT) specialist will be needed at each school, to assist teachers who might face technical problems. It emerged, from the qualitative interviews, that an ICT specialist was deployed by the DoE to each school. The ICT specialist assisted teachers in solving software challenges, but could not solve the hardware problems that the teachers would sometimes face. For instance, at School A all smart boards were not working and there was no ICT technician to fix them. The result was that the teachers abandoned ICTs and resorted to the traditional mode of teaching. They lamented the absence of a technician at the schools. Thus, the majority of the respondents rated ICT support personnel as very important (see Table 8.25). These findings were similar to those of a research study conducted by Kabe, Kalema and Motjolopane (2015) at secondary schools in the Tshwane District. The study revealed that providing ICT facilities to schools had realised little benefits towards e-learning success due to insufficiently trained ICT facilitators, among other things.

9.4.2 Support from the school management team

Teachers require adequate support from the school managers in order to fully utilise ICTs in teaching and learning (Amnat, Boonchan & Pariyaporn 2019). Both the quantitative and qualitative studies revealed that teachers needed more support from the school principals. The majority of respondents, almost 80 per cent, rated a lack of support from school managers an important to a very important barrier to the adoption of ICTs. It was established, through qualitative interviews, that the support that teachers needed included continuous ICT training, provision of technical support and the provision of adequate ICTs. However, discussions with the school principals revealed that they all supported the adoption and use of ICTs in teaching and learning. A similar finding was obtained at a New Zealand school where the principal supported the use of ICTs in the classroom (Zaka 2013). Thus it can be argued that schools led by principals who support the use of technologies in the classroom are most likely to integrate ICTs faster than schools where principals are not supportive (Southworth 2005). Amnat et al 's (2019) study on the perceptions of ICT leadership of school administrators in Thailand revealed that school managers encouraged teachers and students to use ICTs in teaching and learning.

9.4.3 Support from the government

The teachers also needed support from the Department of Education (DoE) to fully use ICTs in teaching and learning (Ghavifekr & Rosdy 2015). The quantitative findings revealed that most teachers rated a limited support from the government a very important barrier to the use of ICTs in teaching, as indicated by high mean scores for infrastructure and support related challenges (see section 8.16.1). The qualitative data gathered through discussions with teachers also confirmed that limited support from the government was an important barrier. The qualitative interview participants argued that support from the DoE was a necessity. The teachers stated that the DoE should organise ICT skills training courses for a longer period of time and not limit the training to three days. A similar finding was obtained in Quebec, Canada by Rabah (2015), where some English teachers argued that although they were trained three or four times in a year on how to use ICTs in the classroom, that was inadequate.

In the current study, the teachers acknowledged that the DoE gave some Grade Eleven teachers laptops in fulfilment of the initiated ICT projects. The ICT projects were meant to improve the quality of teaching and learning in South African schools, such as the Teacher Laptop Initiative (see section 4.8.5). However, some of the laptops had irrelevant material uploaded on them and others did not have any teaching material uploaded. Teachers also needed laptops for lesson preparation and smart boards in all classrooms, as well as an internet connection. A similar finding was obtained by du Plessis and Webb (2012b) at some schools in the Missionvale Township of Port Elizabeth, where teachers desired more computers, more internet connections and support from the Department of Education. Inadequate ICT infrastructure and a limited access to ICTs at schools could, therefore, lead to information poverty.

Furthermore, it is posited that the use of exercise books is out-dated for learners living in the digital world (Van Deursen, ben Allouch & Ruijter 2016). However, it emerged from the discussions with teachers, that the DoE officials expected the learners to write in their hard copy class work books instead of using tablets. That contradicted the Gauteng MEC’s objective to turn schools into paperless classrooms. Furthermore, teachers also stated that they were not skilled on how to mark learners’ work if written on tablets.

It was established, in the qualitative interviews with some teachers, that learners returned tablets to the DoE at the end of each year. However, some learners did not return the tablets and that reduced the number of the tablets. The implication was that if only a few tablets were returned by learners, it automatically reduced the number of tablets that would be available for the following group of grade twelve learners. The number of tablets that learners had access to dwindled yearly due to theft and an increase in enrolment in some instances.

The conclusion can be drawn that that adoption and use of ICTs in the classroom can only be a success if the challenges faced by teachers are addressed. However, the availability and accessibility of ICTs to some teachers does not necessarily mean usage. Thus, this research study sought to find out how often teachers used the available ICTs at home and in teaching and learning.

9.5 Teachers' use of ICTs

The actual use of ICTs is the ultimate goal of material access (Van Dijk 2012). This study revealed that ICT usage among teachers differed. Hence the third sub-research objective of this study was to establish factors that influence the integration of ICTs in teaching and learning.

9.5.1 Teachers' use of ICTs at home

Most teachers used a smart phone daily compared to other ICTs that they had access to. Statistically, it can be deduced that though some teachers accessed ICTs at home, they were not using the technologies every day (see Table 8.3). For instance, approximately 80 per cent of the teachers had access to a computer, but only a third used this technology every day. This confirms Van Dijk's (2005) finding that some individuals who have access to ICTs, choose not to use them. This researcher is of the view that some teachers might not have necessarily chosen not to use ICTs, but that there are other conditions that limit them from using the technologies. These include the high costs of internet access and limited ICT skills as revealed through interviews in this study (see section 7.2).

It is possible that teachers who accessed and used ICTs at home might also use the technologies in the classroom if the ICT infrastructure is made available at schools. Hence, the next section mainly focuses on discussing ICTs available at schools for teaching and learning.

9.5.2 Teachers' use of available ICTs in teaching

The use of ICTs is affected by the availability of infrastructure, among other things (Goyal, Purohit & Bhagat 2010). Quite a large percentage, 45.70 per cent (N=43) of the teachers did not use smart boards in teaching at all since the boards were only installed in some Grade Eleven and Twelve classrooms. Some of the smart boards were not even working at the time that this study was conducted. The use of such ICT infrastructure in teaching and learning was, thus, limited to a few learners and teachers. It was established, through discussions, that some teachers who had access to smart boards did not use them. Time constraints were one of the important reasons cited for not using smart boards (see section 9.4.4). This finding concurs with a finding obtained at the Royal University of Bhutan, where some lecturers revealed that time was a constraining factor to the use of ICTs in teaching and learning (Penjor, Dupka & Zander 2016). Therefore, both findings for this study and Penjor et al's findings confirm Van Dijk's (2012) argument that ICTs usage has various determinants, such as time and availability of the infrastructure.

Less than 10 per cent of the teachers used computers all the time, while approximately a third did not use computers at all in teaching. Computer laboratories at schools were either empty or had dysfunctional computers. It emerged, through interviews, that it was only a few teachers who used the internet in teaching. Hence most teachers were disconnected from the information society at school.

9.6 The purposes and how teachers use ICTs in teaching

The actual use of ICTs is the ultimate goal of the total process of access (Van Dijk 2012). It is posited that the use of ICTs is determined by the length of time used, the applications used, the use of broadband or narrowband, and the creative use of technology (Van Dijk 2012).

The third objective of this study was to establish factors that influence the integration of ICTs in teaching and learning and these were obtained from the research participants. Both the quantitative and qualitative findings revealed that some teachers had some technological knowledge (TK). The technologies that they used included hardware such as smart boards and computers, software for instance Microsoft Word and PowerPoint Presentations. The teachers explained that they used ICTs in teaching, to address the varying needs of learners. For instance, teachers teaching Life Sciences, Physical Sciences and Geography explained that they taught abstract concepts using smart boards, which resulted in enhanced learner understanding of the concepts. Such teachers were at exploration level of TPACK, they teach using learner-centred methodologies and actively engage learners in class activities (Niess et al 2009)

However, it was deduced from the qualitative discussions that the activities that they engaged learners in involved low level thinking activities which were teacher directed, for example, recalling information. Some of the teachers explained that they used the smart board as if it were a chalkboard due to limited digital skills. It can, thus, be argued that some teachers used ICT devices as add-ons in the classroom. Such teachers were at the adaption level of TPACK. They integrated ICTs in teaching and learning but the activities that they engaged learners involved low-level thinking activities which are teacher directed (Niess et al 2009).

The teachers in the current study stated that they used PowerPoint to present lessons, some used Microsoft Word to type notes, some captured marks on the laptops, and others used the internet to search for information. This further indicated that the teachers were at the adaption level of TPACK. Those who used the internet explained that they used their money to buy data bundles and it was expensive. Thus, teachers did not have advanced ICT skills. These findings concur with those of a study conducted by PanAf (2008-2011) at ten South African public schools and also findings of Koh, Chai, Hong and Tsai (2015). The

PanAf study revealed that teachers' technological proficiency was very low and they could only use computers for writing lesson plans and tests for their students. Koh et al found that teachers' approach to ICT lessons showed them to be mainly using ICTs to transmit information to students.

Other purposes that teachers used ICTs for in teaching and learning were deduced from the quantitative study (see Table 8.20). The quantitative findings revealed that some teachers used ICTs to assess learners on an e-learning platform. However, it was, for instance, only a very small percentage - less than five per cent - of the teachers who always assessed learners on e-learning platforms. The majority of the teachers - approximately 80 per cent - did not assess learners on e-learning platforms. Some teachers, about 13 per cent, however, indicated that they did track learners' progress on an e-learning platform. Again, it was only a few who tracked learners on an e-learning platform. It can be concluded that most teachers in this study lacked technological pedagogical knowledge (TPK). Thus, only a few teachers used ICTs for various purposes to enhance teaching and learning. It can also be, derived from Table 8.21, that teachers were at different technological and pedagogical and content knowledge (TPACK) levels (see section 5.3), with the majority at the adaption level (Neiss, Driskell & Hollenbrands 2016). This might further explain the limited use of ICTs in the classroom.

9.7 The impact of ICTs on teaching and learning

The teachers' beliefs about the effectiveness of ICTs in teaching and learning might either result in teachers using the technologies in teaching or prevent them from adopting ICTs (Ogrezeanu & Ogrezeanu 2014; Agbo 2015). Both positive and negative effects of using ICTs in the classroom were voiced by the teachers. Thus this section also establishes factors that influence the integration of ICTs in teaching and learning and that addressed the third sub-research objective in this this study.

9.7.1 Learner performance

Contradicting views on the effectiveness of ICTs on learner performance were obtained from the qualitative interviews. Some teachers believed that the use of ICTs in teaching indeed improved learner performance. A Geography teacher explained that his results improved when he started using ICTs in teaching. Similar findings were obtained from a study on the Khanya project. Learners at schools that received the ICT-based Master Maths programme had significantly better Mathematics scores than those at schools which did not receive the ICT-based Master Maths (Wagner, Day, James, Kozma, Miller and Unwin 2005).

In contrast, some teachers and a school principal believed that ICTs did not improve learner performance. A Physical Sciences teacher said that Matriculation results at his subject actually dropped after learners were given tablets. The quantitative findings also revealed that, for instance, a quarter of the teachers disagreed that ICTs improved learner performance (see Table 8.32). Reasons posited for the drop in learner performance included that learners used tablets for entertainment rather than for educational purposes. These opinions were refuted by a school principal who sighted an improvement in the matriculation results at his school after the adoption and use of ICTs.

It also emerged, from the qualitative data, that most teachers agreed that the use of ICTs was beneficial to their subject areas. Some teachers argued that ICTs catered for the visual, auditory and sensual learners. This finding concurred with Valk, Rashid and Elder (2010). Valk et al argued that the use of portable devices such as tablets allows teachers to personalise learning, to suit each individual learners' needs. The ability to cater for learners' different learning styles might be an indication of advanced ICT skills among some teachers. However, some teachers viewed the use of ICTs as a mere waste of time.

Some of the teachers, for instance an English teacher, argued that she believed in hard copy textbooks when teaching English Literature and that learners should touch and underline important aspects in the textbook. A similar finding was obtained at some Chinese secondary schools in Malaysia, where elderly teachers believed in traditional methods of teaching and learning which allowed learners to use their senses of touching, feeling and learning (Raman & Yamat 2014). Furthermore, concurring with Muslem, Yusuf and Juliana (2018), the English teacher in this study explained that the computer changed spellings when learners typed and that learners had a tendency of writing words in short form. Another English teacher in this study, however, argued that he taught listening skills using a smart board. This concurred with Balagiu, Pateşan and Zechia (2018) who argued that ICTs can assist learners to improve listening and speaking skills. It can be argued that contradictions between the practices of the various English teachers might be an indication of differences in the levels of ICT skills that the teachers possessed.

This study also found that a quarter of the teachers were, however, uncertain that ICTs could make lesson plans richer. Those could be home language teachers who had no access to teaching courseware on the smart boards. It might also be Grades Eight to Ten teachers who had no access to ICTs for teaching and learning.

9.7.2 Accessible learning

Agbo (2015) argued that the use of ICTs in learning is seen as a means to improve accessibility, efficiency and quality of learning by facilitating access to resources and services, as well as remote exchanges and collaboration. The same view was echoed by some teachers in one of the focus group discussions at School A. The teachers mentioned that learners were connected to one another through chat groups and the use of ICTs such as tablets made it possible to reach learners beyond the classroom. This indicates that such teachers had TPACK and were thus at the exploration level (Neiss, Driskell & Hollenbrands 2016). However, this finding contradicts the views of other teachers. Most teachers argued that learners used the tablets predominantly to access the installed e-books and past examination question papers. In some instances, some learners' tablets had no e-books installed. The few teachers' laptops even had irrelevant content installed. Most teachers had no access to tablets, the internet, computers and laptops at schools and in some instances even at home. Thus, they could not communicate with learners beyond the classroom walls. Data gathered quantitatively indicated that half of the teachers (see Table 8.32) disagreed that the use of ICTs in teaching and learning promoted learner to learner interaction.

9.7.3 Negative effects of ICTs

Gerald, MacLeod, Frost and Waller (2017) postulated that some learners sometimes used mobile phones to text their friends during the lesson. Similar findings were obtained in this current study. Almost a third of the teachers (see Table 8.32), agreed that ICTs were disruptive in teaching and learning. This also aligned with findings from the focus group discussions with teachers. A group of teachers argued that ICTs disrupted teaching and learning when they were rolled out at their school in 2016. They stated that some learners were not attending classes but were entertaining themselves by watching movies and playing music on tablets. Teachers further explained that some learners either took pictures of teachers or video-recorded them whilst teaching. Teachers said that they felt uncomfortable and that distracted them during teaching. It was also established, through discussions with teachers, that some learners posted teachers' photographs on social media.

9.8 Possible solutions to the challenges faced by teachers in their adoption and use of ICTs in teaching and learning

The challenges identified should be addressed if successful adoption of ICTs is to be achieved (Lateh & Muniandy 2010). Thus, the last objective of this study sought to proffer possible solutions to the challenges faced by teachers in their adoption and use of ICTs in teaching and learning.

It was gathered from a school principal that some teachers were technophobic. The principal suggested that such teachers should be motivated and be intensively trained regularly on how to use ICTs in teaching. The same school principal explained that such teachers would have to improve their ICT skills and use ICTs in the classroom because “ICTs are here to stay”. This finding concurred with Sarrocco (2002) who posited that an information society is here and it is irreversible, “like a force of nature, the digital age cannot be stopped” (Negroponte 1995:229). Some teachers agreed with the school principal and suggested that teachers should be regularly trained on how to use ICTs since some of them had limited skills.

School principals and teachers echoed the same sentiment that ICT infrastructure such as smart boards should be regularly maintained, and needed a school-based ICT technician. They all agreed that the entire schools should be connected on high speed internet. Access to ICTs should be made available to all teachers and learners.

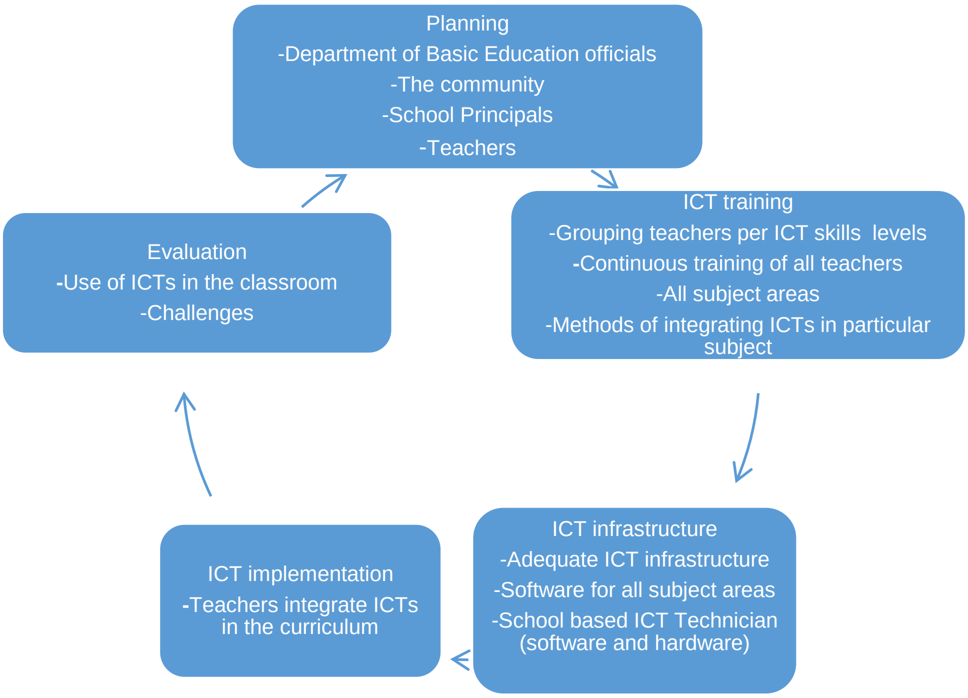
Teachers proposed that security at schools should be tightened to prevent theft of the ICT infrastructure such as computers, internet routers and electricity cables. The installation of cameras in the classrooms to prevent learners from vandalising smart boards was also proposed. However, some teachers rejected that proposition arguing that they would not feel comfortable teaching in classrooms with installed cameras.

This thesis has given an account of and the reasons for limited ICT use in the classroom. That includes, limited ICT skills among teachers, a lack of ICT support personnel and inadequate ICT infrastructure. These challenges could be alleviated if the rolling out of ICTs in schools is evaluated and an ICTs model is recommended in the next section.

9.9.1 Recommendations for the adoption and use of ICTs

Deducing from both qualitative and quantitative findings, as well as from the theoretical chapters, this study recommends an ICTs adoption and use model that can be implemented, as illustrated below in Figure 9.1.

Figure 9. 1: Chisango's 2019 Recommended ICTs model



First step: Planning

It is recommended that stakeholders such as teachers, the community, and the Department of Education (DoE) officials be part of the planning for the adoption and use of ICTs at schools. The DoE are the policy makers and should involve all relevant stakeholders as identified in this model. School principals manage schools and might support teachers in the use of ICTs in the classroom. Teachers should be involved in the planning for the adoption and use of ICTs at schools, since they are the implementers of the technologies in the classroom. Classroom realities are known by teachers more than anyone else. Involving teachers, rather than merely imposing ICTs on them, might motivate some teachers to adopt and use ICTs. The community and /or parents, play an important role in the use of technologies in schools. It is argued that some parents still believe in traditional methods of teaching and learning (Zaka 2013). Therefore, involving them when planning the implementation of ICTs in schools might change their views of teaching methodologies. This might also result in parents knowing the importance of ICTs in the classroom. It is also the community that can protect schools from theft and vandalism of ICTs.

Second step: ICT training

Teachers have different levels of ICTs skills. This study suggests that it is crucial that an ICT skill needs analysis be conducted first before teachers are trained. Teachers with similar levels of ICT skills should be trained together. In addition to that, very teacher should be equipped with digital skills, regardless of the grade that he or she teaches. ICT training should also be continuous, and that can be done at schools. Furthermore, for effective adoption and use of ICTs in teaching and learning, the Department of Education officials need to evaluate the ICT training that teachers undergo to assess the depth of ICT skills acquired by teachers. Follow-ups on the impact of ICT training should be done in order to assess if teachers implement the acquired skills.

Third step: ICT support

Research participants suggested the support that they needed and this researcher also agrees with those suggestions. Support includes a school-based ICT Technician, software for all subject areas, including Home Languages, provision of adequate ICT infrastructure for all teachers, including high speed internet connectivity.

Fourth step: ICT implementation

If all teachers' needs with regards to the adoption and use of ICTs in teaching and learning are addressed, then teachers might effectively and efficiently use technologies in the classroom. Thus, this study suggests that the Department of Education and other stakeholders need to conduct a comprehensive ICTs needs analysis of teachers before rolling out ICT infrastructure at schools.

Fifth step: Evaluation

This study suggests that it is of great importance to evaluate the whole process of ICTs adoption in schools. Education officials need to evaluate the implementation of the ICTs in the classroom. Evaluating the implementation of ICTs in schools might bring to light challenges that some teachers might be facing. Further suggestions are that Education officials should continuously visit schools that had ICTs rolled out to, in order to assess ICT implementation. There is also a need to evaluate the ICT related professional development courses that are afforded to teachers.

9.9 Delimitations of the study

A delimitation of this study is that it only focused on three township secondary schools in one particular municipal area, namely the Sedibeng West District, Gauteng Province, South Africa. This study only focused on teachers and the school principals to explore ICTs adoption and use at township secondary schools. Schools in one township were considered in this study. The situation could be very different from other provinces in South Africa, as well as in rural areas. Further insights could have been obtained by involving learners.

Considering the sample size used, the findings cannot be generalised to the broader population. Although a probability sampling technique was used (census-type sampling), a large number of teachers did not participate. The fact that only about two-thirds of the teachers participated in the study, impinges on the drawing of generalisations from the study.

The sample size is relatively small. The sample size limited statistical analyses and the findings cannot be generalised to all teachers. The major problem that hinders generalisation is the fact that a large percentage of teachers preferred not to participate. There could have been specific reasons that some teachers preferred not to participate. The teachers that did participate could, for example, had more confidence to use ICTs than those who withdrew from the study.

Another limitation is that I quantitatively gathered data on teachers' levels ICTs competencies and also discussed how teachers used ICTs in teaching and learning. I did not explore other methods which can be used to collect such data, for instance lesson observations.

In addition, the study focused on only one specific area. The results may therefore, not be generalised to other areas.

9.10 Recommendations for further study

In light of the stated limitations of this study, this research study recommends that data can be collected from a larger population. Other schools and other areas should also be covered. In particular, schools in more rural areas should be covered.

This study only focused on teachers and school principals to collect data. I recommend that further studies may be done which involve learners, the relevant department of education officials, such as subject advisors, and the community at large. I am of this view since her findings revealed that the learners and the community also impact the adoption and use of ICTs in teaching and learning.

I recommend that observing teachers during teaching and learning might be done to rate the level of teachers' ICT skills, rather than relying on discussions and a survey questionnaire.

Furthermore, I recommend that a comparative study of township secondary schools and schools in affluent suburbs could be done. Comparisons could be made with other parts of South Africa, for example, schools in other provinces, including rural areas.

Follow-up studies could also focus on various ways to improve the ICT skills of teachers as skills was such an important factor that influence ICT integration in teaching and learning.

9.11 Conclusion

It is important to note that the fact that the Gauteng Provincial Department of Education rolled out ICTs in schools means that the province endeavours connecting teachers and learners to the information society. In this study, some teachers that had access to ICT infrastructure, integrated the technology in their teaching. The teachers, however, faced intrinsic and extrinsic barriers. However, conclusions can be drawn that enhancing the ICT skills of teachers could promote the use of ICTs in teaching and learning despite the numerous barriers that teachers face in townships. It also appears that if teachers have the necessary skills, they will find a way to integrate ICTs despite the barriers that existed at these particular schools.

SOURCES CONSULTED

Abrahams, L. 2011. South Africa's e-development still a futuristic task. *Journal of the Knowledge Economy,* 2(1):145-171.

Abuhmaid, A. 2011. ICT training courses for teacher professional development in Jordan. *The Turkish Online Journal of Educational Technology*, 10(4):195-210.

Adams, A & Cox, AL. 2008. Questionnaires, in-depth interviews and focus groups, in *Research Methods for Human Computer Interaction*, edited by P, Cairns and Cox. Cambridge: Cambridge University Press: 17-34.

Adams, R. 2014. Education study finds in favour of traditional teaching styles. *The Guardian*, 31 October. [O]. Available:
https://www.theguardian.com/education/2014/oct/31/education-traditional-teaching-versus-progressive
Accessed on 2018/09/28

Adam, AS. 2017. A framework for seeking the connections between technology, pedagogy, and culture: a study in the Maldives. *Journal of Open, Flexible and Distance Learning,* 21(1): 35-51.

Adegoke, AS, Babalola, IT & Balogun, WA. 2008. Performance evaluation of GSM mobile system in Nigeria. *The Pacific Journal of Science and Technology,* 9(2):436-441.

Adejimi, A, Oyediran, OS & Ogunsanmi, EB. 2010. Employing qualitatively enriched semi structured questionnaire in evaluating ICT impact on Nigerian construction chain integration. *The Built & Human Environment Review,* 3(1): 49-62.

Adu, EO. 2016. *E-learning facilities usage assessment by economic and management science (EMS) teachers in Eastern Cape Province, South Africa* (Paper read at the world conference on educational media and technology, Vancouver, BC, Canada on 28 June 2016). [O].Available:

https://www.learntechlib.org/primary/p/173182/
Accessed on 2018/10/22

African Development Bank Group. 2014. *Tracking Africa's progress in figures.* Tunis: Statistics Department. Chairman: M Ncube. [O]. Available: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Tracking_Africa%E2%80%99s_Progress_in_Figures.pdf
Accessed on 2018/02/13

Agbo, IS. 2015. Factors influencing the use of information and communication technology (ICT) in teaching and learning Computer studies in Ohaukwu local government area of Ebonyi State-Nigeria. *Journal of Education and Practice,* 6(7): 71-86.

Ajelabi, PA & Agbatogun, A. 2010. Perception of Nigerian Secondary School Teachers on Introduction of e-Learning Platforms for Instruction. *US-China Education Review,* 7(12): 83-88. [O]. Available:
http://0-eds.b.ebscohost.com.oasis.unisa.ac.za/eds/detail/detail?sid=c95c57da-0998-4795-8f74
Accessed 2018/12/17

Aktaruzzaman, MD, Shamim, MDRH & Clement, CK. 2011. Trends and issues to integrate ICT in teaching learning for the future world of education. *International Journal of Engineering & Technology,* 3(11):114-119.

Al-Ansari, H. 2006. Internet use by the faculty members of Kuwait University. *The Electronic Library*, 24(6):791-803.

Albright, KS. 2005. Global measures of development and the information society. *New Library World,* 106 (1214/1215):320-331.

Almalki, S. 2016. Integrating quantitative and qualitative data in mixed methods research - challenges and benefits. *Journal of Education and Learning*, 5(3):288-296.

Akinsola, OS, Herselman, ME & Jacobs, SJ. 2005. ICT provision to disadvantaged urban communities: a study in South Africa and Nigeria. *International Journal of Education and Development using Information and Communication Technology,* 1 (3):19-41.

Alampay, G. 2007. The Role of Governments in Promoting ICT Access and Use by SMEs Considerations for Public Policy*. APDIP e-Note 12*. [O]. Available: http://www.apdip.net/apdipenote/12.pdf
Accessed on 2018/01/18

Albugami, S & Ahmed, V. 2015. Success factors for ICT implementation in Saudi secondary schools: from the perspective of ICT directors, head teachers, teachers and students. *International Journal of Education and Development using Information and Communication Technology*, 11(1):36-54.

Alenezi, A. 2015. Influences of the mandated presence of ICT in Saudi Arabia secondary schools. *International Journal of Information and Education Technology*, 5(8): 638-644.

Aliber, M, Kirsten, M, Maharajih, R, Nhlapo-Hlope, J & Nkoane, O. 2006. Overcoming underdevelopment in South Africa's second economy. *Development Southern Africa,* 23(1):45-61.

Alonso, F, López, G, Manrique, D & Manrique, JM. 2005. An instructional model for web-based e-learning education with a blended learning process approach. *British Journal of Educational Technology,* 36(2): 217-235.

Al-Nasrawi, S & Zoughbi, S. 2015. Information society, digital divide, and e-governance in developing countries, in *Encyclopaedia of information science and technology,* edited by M khosrow-Pour*.* 3rd edition. Hershey, PA: IGL Global: 2015-2059. [O].Available:
https://www.igi-global.com/book/encyclopedia-information-science-technology-third/76156
Accessed on 2018/08/27

Amnat, A, Boonchan, S & Pariyaporn, T. 2019. Information and communication technology leadership of school administrators in Thailand. *International Journal of Instruction*, 12(2):639-650.

Anaraki, LN, & Heidari, A. 2010. Bridging the digital divide: a review of critical factors in developing countries, in *Developing sustainable digital libraries: socio-technical perspectives,* edited by T Ashraf, J Sharma, & P Gulati. Hershey, PA: IGI Global: 286-310.

Anney, VN. 2014. Ensuring the quality of the findings of qualitative research: looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and Policy Studies,* 5(2): 272-281.

Anderson, JE, Schwager, PH & Kerns, RL. 2007. The drivers for accepting tablet PC by faculty in college of business. *Journal of Information Systems Education,* 17(4): 429-440.

Anyanwu, R, Le Grange, L & Beets, P. 2015. Climate change Science: the literacy of Geography teachers in the Western Cape Province, South Africa. *South African Journal of Education,* 35(3):1-9.

Apartheid 'no longer an excuse'. 2007 *Brand South Africa*. [O]. Available: https://www.brandsouthafrica.com/governance/education/mediocrity
Accessed on 2019/01/04

Aqili, SV. 2008. Bridging the digital divide: The role of librarians and information professionals in the third millennium. *The Electronic Library,* 26(2):226-237.

Arbaugh, J, Godfrey, M, Johnson, M, Pollack, B, Niendorf, B & Wresch, W. 2009. Research in online and blended learning in the business disciplines: key findings and possible future directions. *Internet and Higher Education,* 2(12): 71-87.

Armenta, A, Serrano, A, Cabrera, M, & Conte, R. 2012. The new digital divide: the confluence of broadband penetration, sustainable development, technology adoption and community participation. *Information Technology for Development,* 18(4):345-355.

Armstrong, TOYJP & Fuhr, JR. 1993. Cost Considerations for Rural Telephone Service. *Telecommunications Policy*, 17(1):80-83.

Arzi, HJ & White, R. 2008. Change in teachers' knowledge of subject matter: a 17-year longitudinal study. *Science Education*, 92(2):221-251.

Askonas, P & Steward, A. 2000. *Social inclusion: possibilities and tensions*. London: Macmillan.

Assan, T & Thomas, R. 2012. Information and communication technology integration into teaching and learning: opportunities and challenges for Commerce educators in South Africa. *International Journal of Education and Development using ICT,* 8(2):4-16.

Asongu, S. 2015. The impact of mobile phone penetration on African inequality. International *Journal of Social Economics,* 42(8):706-716.

Avgerou, C & Madon, S. 2005. Information society and the digital divide problem in developing countries. London school of economics. [O]. Available: http://eprints.lse.ac.uk/2576/1/Information_society_and_the_digital_divide_problem_in_developing_countries_(LSERO).pdf
Accessed on 2019/05/25

Aytaç, T. 2013. Interactive whiteboard factor in education: students' points of view and their problems. *Educational Research and Reviews,* 8(20):1907-1915.

Axinn, WG & Pearce, LD. 2006. *Mixed method data collection strategies*. New York: Cambridge University Press.

Babbie, E & Mouton, J. 2010. *The practice of social research*. Cape Town: Oxford University Press.

Bagchi, K, Udo, G & Kirs, P. 2007. Global diffusion of the internet XI: the internet growth in Africa: some empirical results. *Communications of the Association for Information Systems*, 19(2007):325-351.

Bagula, A, Zennaro, M, Nungu, A & Nkoloma, M.2011. *Bridging the digital divide in Africa: a technology perspective* (Paper read at the 2011 wireless communication and information on digital divide and mobile applications, Berlin, Germany on 20-21 October 2011). [O]. Available:
http://wireless.ictp.it/Papers/WCI2011.pdf
Accessed on 2019/07/23

Balagiu, A, Pateşan, M & Zechia, D. 2018. *Language Learning and ICT* (Paper read the 14th international scientific conference e-learning and software for education, Bucharest, Romania on 19-20 April 2018). [O]. Available:
http://www.proceedings.elseconference.eu/
Accessed on 2019/03/16

Ballinger, C .2008. Accountability, in *The sage encyclopedia of qualitative research methods*, edited by LM Given. Calif: Sage: 4-5. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963909.n3 2015/12/16
Accessed on 2018/12/16

Bahrini, R & Qaffas, AA. 2019. Impact of information and communication technology on economic growth: evidence from developing countries. *Economies,* 7(21):1-13.

Barnes, S. 2015. *How better connectivity can transform Africa's economies.* [Sl]: World Economic Forum. [O]. Available:
https://www.weforum.org/agenda/2015/06/how-better-connectivity-can-transform-africas-economies/
Accessed on 2018/01/06

Barnley, J. 2012. 40 % of Sub-Saharan Africa face digital divide over broadband access*. Domaining Africa,* 22 September. [O]. Available:

http://domainingafrica.com/40-of-sub-saharan-africa-face-digital-divide-over-broadband-access/
Accessed on 2018/09/04

Barron, I & Curnow, R. 1979. *The future with microelectronics: forecasting the effects of information technology*. London: Frances Pinter.

Battaglia, M. 2008. Purposive sample, in *Encyclopedia of survey research methods*, edited by PJ Lavrakas. Calif: Sage: 646. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963947.n419
Accessed on 2018/10/08

Becla, A. 2012. Information society and knowledge-based economy-development level and the main barriers-some remarks. *Economics and Sociology,* 5(1):125-132.

Bell, D. 1973. *The coming of post-industrial society: a venture in social forecasting.* New York: Basic Books.

Bell, D. 1979. The Social Framework of the Information Society, in *The computer age: a 20-year view*, edited by ML Dertouzos and J Moses. Cambridge, MA: MIT Press: 500-549.

Belgium. Recommendations to the European Council Europe and the global information society. 1994. *Report on Europe and the Global Information Society.* Brussels. Chairman: M Bangemann. [O]. Available:
http://www.cyber-rights.org/documents/bangemann.htm
Accessed on 2018/07/15

Bermejo, S. 2005. Cooperative electronic learning in virtual laboratories through forums. *IEEE Transactions on Education, 48*(1):140-149.

Beukes-Amiss, CM & Chiware, ERT. 2006. The impact of diffusion of ICTs into educational practices, how good or how bad? A review of the Namibia situation. *A Journal of the Namibian Educational Research Association,* 2(5):28-45.

Bezold, C & Olson, RL. 1986. The coming of post-industrial society. New York: Basic Books.

Billion, M, Rocio, M & Lera-Lopez, F. 2009. Disparities in ICT adoption: a multidimensional approach to study the cross-country digital divide. *Telecommunications Policy*, 1(33): 596-610.

Bitsch, V. 2005. Qualitative research: a grounded theory example and evaluation criteria. *Journal of Agribusiness,* 23(1): 75-91.

Boguslaw, O, Scott, W & Jill, C. 2017. *How "blended" should "blended learning" be?* (Paper read at the EUROCALL 2017 conference, Southampton, United Kingdom, on 23-26 August 2017). [O]. Available:
https://files.eric.ed.gov/fulltext/ED578290.pdf
Accessed on 2019/07/23

Bornman, E. 2003. Struggles of identity in the age of globalisation. *Communicatio*, 29 (1&2): 24-47.

Bornman, E. 2012. The Mobile phone in Africa: has it become a highway to the information society or not? *Contemporary Educational Technology,* 3(4): 278-292.

Bornman, E. 2014. *Access to the internet and mobile phones in South Africa: the results of longitudinal studies* (Paper read at the international conference on communication, media, technology and design, Istanbul, Turkey on 24-26 April 2014). [O]. Available:
http://www.cmdconf.net/2014/pdf/2.pdf
Accessed on 2019/07/23

Bornman, E. 2016. Information society and digital divide in South Africa: results of longitudinal surveys. *Information, Communication & Society,* 19(2):264-274.

Bower, M. 2015. A typology of Web 2.0 technologies. [SI]: EDUCAUSE. [O]. Available:

https://library.educause.edu/resources/2015/2/a-typology-of-web-20-learning-technologies
Accessed on 2018/08/15

Brantley-Dias, L & Ertmer, PA. 2013. Goldilocks and TPACK: is the construct 'Just Right'? *Journal of Research on Technology in Education*, 46(2): 103-128.

Braun, V & Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2): 77-101.

Broadband Commission. 2013. *The state of broadband 2013: Universalising broadband*. Geneva: UNESCO.

Bull, G & Bell, L. 2009. TPACK: a framework for the CITE journal. *Contemporary Issues in Technology and Teacher Education,* 9(1): 1-3.

Burke, M. 2012. One: a decade of e-government research in Africa. *The African journal of information and communication,* 1(12): 1-24.

Africa: Mobile Penetration in Africa Hits 80pc. 2017. *Business Day Ghana*, 27 April. [O]. Available:
http://allafrica.com/stories/201704251054.html
Accessed on 2018/08/30

Blackman, C. 2002. Bridging the global digital divide a costly mistake? *Info,* 4(3):1-11. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.1108/info.2002.27204caa.001
Accessed on 2019/06/04

Bless, C, Sithole, S & Higson-Smith, C. 2013. *Fundamentals of social research methods: an African perspective*. Cape Town: Juta.

Blignaut, AS & Howie, SJ. 2009. South Africa's readiness to integrate ICT in Mathematics and Science pedagogy at secondary schools. *Education and Information Technologies*, 14(4):345-363.

Botha, A & Herselman, M. 2014. *A conceptual framework for integrating mobile technology into resource-constrained rural schools* (Paper read at the IST Africa proceedings, Mauritius on 6-9 May 2014). [O]. Available:
http://www.ict4red.co.za/project-type/publications/
Accessed on 2018/08/10

Braverman, B. 2016. The digital divide: How income inequality is affecting literacy instruction and what all educators can do to help close the gap*. Literacy Today*, 33(4): 16-20.

Brosnan, MJ. 2002. The impact of computer anxiety and self-efficacy upon performance. *Journal of Computer Assisted Learning,* 14(3):223-234.

Bryman, A. 2012. *Social research methods*. Oxford: Oxford University Press.

Bryman, A & Bell, E. 2011. *Business research methods*. 3rd edition. Oxford: Oxford University Press.

Cairncross, F. 2001. *The death of distance 2.0*. London: Texere.

Calandro, E, Gillwald, A, Moyo, M, & Stork, C. 2010. *Comparative ICT sector performance review* 2009/2010. Cape Town: Research ICT Africa.

Campbell, D. 2001. Can the digital divide be contained? *International Labour Review*, 140(2).

Campbell, JL, Quincy, C, Osserman, J & Pedersen, OK. 2013. Coding in-depth semi-structured interviews: problems of unitization and inter-coder reliability and agreement. *Sociological Methods & Research,* 42(3): 294-320.

Castells, M.1994. European cities, the informational society, and the global economy. *Tijdschrift voor economische en sociale geografie*, 84(4):247-257.

Castells, M. 1996. *The information age, economy, society and culture: the rise of the network society*. Volume 1*.* Oxford: Blackwell.

Castells, M. 1999. The information age, e*conomy, society and culture: the power of identity.* Volume II. Oxford: Blackwell.

Castells, M. 2000. *The information age: economy, society and culture*: *end of millennium.* Volume III. Oxford: Blackwell.

Castells, M, Muller, J Cloete, N & Badat, S. 2001. *Challenges of globalisation: South African debates with Manuel Castells.* Cape Town: Maskew Miller.

Castells, M. 2004. *The network society: a cross-cultural perspective.* Cheltenham: Edward Elgar.

Castells, M & Cardoso, G. 2005. *The network society from knowledge to policy*. Washing DC: Johns Hopkins Centre for Transatlantic Relations.

Castells, M. 2010. *The rise of the network society*. West Sussex: Wiley-Blackwell.

Cartelli, A. 2013. *Fostering 21st century digital literacy and technical competency.* Hershey: IGI Global.

Cell phones in Africa: communication lifeline. 2015. Washington, Pew research centre. [O]. Available:
http://www.pewglobal.org/2015/04/15/cell-phones-in-africa-communication-lifeline/
Accessed on 2017/05/22

Chang, SL, Shieh, RS, Liu, EZF & Yu, PT. 2012. Factors influencing women's attitudes towards computers in a computer literacy training program. *Turkish Online Journal of Educational Technology,* 11(4):177-187.

Chen, W & Wellman, B. 2005. Minding the cyber-gap: the internet and social inequality, in *The Blackwell Companion to Social Inequalities*. [SI]: Blackwell: 523-545. [O]. Available:
http://homes.chass.utoronto.ca/~wellman/publications/cybergap/cybergap.pdf
Accessed on 2018/07/22

Choung, ME & Manamela, MG. 2018. Digital inequality in rural and urban settings: challenges of education and information in South African youth context. *Bangladesh e-Journal of Sociology*, 15(2):186-197.

City of Tshwane. 2015. *Welcome to free TshWi-Fi powered by the City of Tshwane.* Pretoria: [sn]. [O]. Available:
http://www.tshwane.gov.za/Pages/WIFI.aspx
Accessed on 2019/05/22

Cohen, L, Manion, L & Morrison, K. 2018. *Research Methods in Education*. New York: Routledge.

Courtney, AM. 2017. The value of mixed methods research: a mixed methods study. *Journal of Mixed Methods Research*, 11(2):202-222.

Cox, S & Graham, CR. 2009. Diagramming TPACK in practice: using and elaborated model of the TPACK framework to analyse and depict teacher knowledge. *TechTrends,* (53)60-69.

Chai, CS, Koh, JH, Tsai, CC. 2013. Exploring the factor structure of the constructs of technological, pedagogical, content knowledge (TPACK). *The Asia-Pacific Education Researcher*, 20(3):595-603.

Chai, CS, Koh, JH, Tsai, CC. 2013. A review of Technological Pedagogical Content Knowledge. *Educational Technology & Society*, 16(2):31-51.

Chadwick, D. 2009. *Approaches to building conceptual understandings*. Wellington: Learning media.

Cheneau-Loquay. A. 2007. From networks to uses patterns: the digital divide as seen from Africa. *GeoJournal*, 68(1): 55-70.

Chetty, K, Aneja, U, Mishra, V, Gcora, N & Josie, J. 2018. Bridging the digital divide in the G20: skills for the new age. *The open-access, open-assessment e-journal,* 12(24):1-24.

Chetty, M, Sundaresan, S, Muckaden S, Feamster, N & Callandro, E. 2013. *Investigating broadband performance in South Africa: towards evidence-based ICT policy and regulation. Volume Two*. [O]. Available:
http://www.researchictafrica.net/docs/RIA_policy_paper_measuring_broadband_performance_South_Africa.pdf
Accessed on 2018/05/27

Chetty, M, Blake, E, & McPhie, E. 2006. VoIP deregulation in South Africa: implications for under-serviced areas. *Telecommunications Policy,* 30(5-6): 332-344.

Chigona, W & Mbhele, F. 2008. The role of the Internet in alleviating social exclusion: the case of the Western Cape Province. *South African Computer Journal*, (41): 75-85.

Chigona, A. 2015. *Teacher education students' domestication of ICTs for teaching and learning* (Paper read at the global conference on learning and technology, Berlin, Germany on 16-17 April 2015). [O]. Available:
https://0www.learntechlib.org.oasis.unisa.ac.za/p/150868/
Accessed on 2018/09/21

Chigona, A. 2010. *An investigation of factors affecting the use of ICT for teaching in the Western Cape schools* (Paper read at the 18th European conference on information systems, Pretoria, South Africa on 7-9 June 2010). [O]. Available:
https://www.researchgate.net/publication/221409106_An_Investigation_of_Factors_affecting_the_Use_of_ICT_for_Teaching_in_the_Western_Cape_Schools
Accessed 2018/05/27

Chigona, A. 2011. ICTs for curriculum delivery: understanding educators' perceptions and experiences of the technology in disadvantaged high schools. *Journal for New Generation Sciences,* 9(1):1-13.

Chigona, A. & Chetty, R. 2012. *Integration of ICTs in teacher education programs in South Africa* (Paper read at the society for information technology & teacher

education international conference, Austin, Texas, USA on 05 March 2012). [O]. Available: https://www.learntechlib.org/primary/p/40003/
Accessed 2018/02/13

Chigona, A, Chigona, W, Kayongo, P & Kausa, M .2010. An empirical survey on domestication of ICT in schools in disadvantaged communities in South Africa. *International Journal of Education and Development using Information and Communication Technology,* 6(2): 21-32.

Chigona, W & Mooketsi, B. 2011. In the eyes of the media: discourse of an ICT4D project in a developing country. *Electronic Journal of Information systems in Developing Countries*, 46(6): 1-16.

Chikasa, S, Ntuli, M, & Sundarjee, R. 2014. ICT integration in teaching: an uncomfortable zone for teachers: a case of schools in Johannesburg. *Education as Change,* 18(1): 137-150.

Chilisa, B. 2012. *Indigenous research methodologies*. London: Sage.

Chisango, G. 2014. *Technology challenges faced by rural women in the Eastern Cape Province of South Africa: A case study in the Chris Hani Municipality*. Pretoria: University of South Africa. (Master's dissertation).

Chisango, G & Lesame, C. 2017. Challenges of information and communication technology policy implementation in rural South Africa. *Communitas,* (22):48-61.

Chisa, K & Hoskins, R. 2014. The effects of information and communication technologies on indigenous communities in South Africa: a library and information science perspective. *Mousaion,* 32(3):49-68.

Chisunka-Mwila, PC, Daka, KL, Mulauzi, F & Njobvu, B. 2010. Integration of ICTs in education: the level at which ICT training should be introduced in Zambian education*. Zambia Library Association Journal,* 25(1&2): 85-94.

Colle, R & Roman, R. 1999. Communication centres and developing nations. [O]. Available:http://www.devmedia.org/document/Banga.htm
Accessed on 2019/07/11

Conradie, P & Jacobs, S. 2003. Bridging the digital divide. *Engineering Management*, 13(1):30-33.

Conradson, D. 2005. Focus Groups, in *Methods in Human Geography: a guide for students doing a research project,* edited by R Flowerdew and D, Martin. London, Pearson: 128-143.

Coşkun, A. 2017. English as a foreign language students' opinions about the use of English on the internet. *Journal on School Educational Technology*, 12(3):10-21.

Costa, C, Alvelos, H & Teixeira, L. 2012. The use of moodle e-learning platform: a study in a Portuguese University. Procedia Technology, (5):334-343.

Creswell, JW. 2003. *Research design: qualitative, quantitative and mixed methods approaches*. Calif: Sage.

Creswell, J. 2007. *Qualitative inquiry and research design: choosing among five approaches*. Calif: Sage

Creswell, JW. 2009. *Research design: qualitative, quantitative, and mixed methods approaches*. Calif: Sage.

Creswell, JW. 2012. *Educational research: planning, conducting and evaluating quantitative and qualitative research*. Boston: Pearson.

Creswell, JW & Plano Clark, VL. 2011. *Designing and conducting mixed methods research*. Calif: Sage.

Creswell, JW. 2012. *Educational Research: planning, conducting and evaluating quantitative and qualitative research*. Boston: Pearson.

Creswell, JW. 2014. *Research design: qualitative, quantitative and mixed methods approaches*. Calif: Sage.

Cullen, R. 2001. Addressing the digital divide. *Online Information Review,* 25 (5): 311–320. [O]. Available:
http://dx.doi.org/10.1108/14684520110410517
Accessed on 2017/01/12

Curry GN, Dumu, E, Koczberski, G. 2016. Bridging the digital divide: everyday use of mobile phones among market sellers in Papua New Guinea, in *Communicating, networking interacting: the international year of global understanding,* edited by M Robertson. Cham: Springer: 39-53.

Czernowalow, M. 2015. No clear vision for tech in schools. *Brainstorm Magazine*, 16 July. [O]. Available:
http://www.itweb.co.za/index.php?option=com_content&view=article&id=144764:No-clear-vision-for-tech-in-schools&catid=116&Itemid=81
Accessed on 2018/06/16

Dang, XT. 2011. *Factors influencing teacher's use of ICT in language teaching: a case study of Hanoi University Vietnam* (Paper read at the international conference ICT for language learning, Florence, Italy on 20-21 October 2011). [O].Available:
https://conference.pixelonline.net/conferences/ICT4LL2011/common/download/Paper_pdf/SLA51-478-FP-Dang-ICT4LL2011.pdf
Accessed on 2018/07/05

Davidovitch, N & Yavich, R. 2017. The Effect of Smart Boards on the Cognition and Motivation of Students. *Higher Education Studies*, 7(1):60-68.

Davids, Z. 2009. *The Educators' Perspective on the Factors that Influence the Success of ICT School Initiatives within the Western Cape*. Cape Town: University of Cape Town. (Masters dissertation).

Davis, NE. 2008. How may teacher learning be promoted for educational renewal with IT? Models and theories of IT diffusion, in *International handbook of information technology in primary and secondary education*, edited by J Voogt & G Knezek. New York: Springer: 507–519.

Deen-Swarray, M. 2016.Toward digital inclusion: understanding the literacy effect on adoption and use of mobile phones and the internet in Africa. *Research ICT Africa,* 12(2): 29-45.

De Haan, J & Rijken, S. 2002. The internet and knowledge gaps: a theoretical and empirical investigation. *European Journal of Communication,* 7(1):65-84.

Dehinbo, J & Odunaike, S. 2009. *Adapting e-learning facilities to serve the rural communities in South Africa: the case of the Soshanguve community* (Paper read at the e-Learn: world conference on e-Learning in corporate, government, healthcare, and higher education, Vancouver, Canada on 26 October 2009). [O]. Available:
https://www.learntechlib.org/primary/p/32840/
Accessed on 2018/11/12

Deji, FO. 2012*. Gender and Rural Development: Advanced studies.* Hamburg: Lit Verlag.

Delaney, J, Johnson, A, Johnson, T & Treslan, D. (2010). *Students' perceptions of effective teaching in higher education.* St. John's: Memorial university of Newfoundland, distance education and learning technologies.

Demombynes, G & Thegeya, A. 2012. Kenya's mobile revolution and the promise of mobile savings. *World Bank Policy Research Working Paper, No. 5988*.

Denzin, NK. 1978. *The research*. New York: Wiley.

Denzin, NK & Lincoln, YS. 2008. *The landscape of qualitative research*. London: Sage.

De Villiers, MR. 2005. E-learning artefacts: are they based on learning theory?

Alternation, 12(1): 345-371.

DiMaggio, P, Celeste, C, Hargittai, E & Shafer, S. 2004. Second-level digital divide: from unequal access to differential use, in *Social inequality*, edited by K Neckerman. New York: Sage: 355-400.

Divaharan, S. 2010. Learning as students to become better teachers: pre-service teachers' IWB learning experience. *Australian Journal of Educational Technology,* 26 (4): 553-570.

Dobermann, T. 2016*. Energy in Myanmar.* [SI]: International growth centre. [O]. Available:
https://www.theigc.org/wp-content/uploads/2016/04/Dobermann-2016-1.pdf
Accessed on 2018/01/08

Dobransky, K and Hargittai, E. 2006. The disability divide in internet access and use. *Information, Communication & Society*, 9(3): 313-334.

Dodson, L & DaSilva, DA. 2011. Enhancing education delivery in Guyana at the general secondary level: opportunities for the use of computer-assisted instruction. *World Journal of Science, Technology and Sustainable Development*, 8(1): 55-67.

Dreyfus, HL. 2001. *On the Internet*. London: Routledge.

Drotner, K & Livingstone, S. 2008*. International Handbook of Children, Media and Culture.* London: Sage.

Drucker, PF.1968. *The age of discontinuity: guidelines to our changing society.* New York: Harper and Row.

Duff, AS. 2002. The status of information society studies in the information science curriculum. *Library Review,* 51(3/4): 139-148.

Dugarova, E & Gülasan, N. 2017. *Challenges and Opportunities in the Implementation of the Sustainable Development Goals.* New York: United

Nations Development Programme and United Nations Research Institute for Social Development.
[O].Available:
https://www.undp.org/content/dam/undp/library/SDGs/English/Global%20Trends_UNDP%20and%20UNRISD_FINAL.pdf
Accessed 2019/05/25

Dutta, S & Bilbao-Osorio, B. 2012. *The global information technology report: living in a hyper connected world.* Geneva: World Economic Forum.

Du Plessis, A & Webb, P. 2012a. Digital immigrant teacher perceptions of an extended cyber hunt strategy. *Australasian Journal of Education Technology,* 28(2): 341-363.

Du Plessis, A & Webb, P. 2012b. Teachers' perceptions about their own and their schools' readiness for computer implementations: a South African case study. *The Turkish Online Journal of Educational Technology,* 11(3): 312-325.

Du Plooy, GM. 2009. *Communication research techniques, methods and applications*. 2nd edition. Cape Town: Juta.

Durndell, A & Haag, Z. 2002. Computer self-efficacy, computer anxiety, attitudes towards the internet and reported experience with the internet by gender in an East European sample. *Computers in Human Behaviour*, 18(5):521-535.

Dzansi, DY & Amedzo, K. 2014. Integrating ICT into rural South African schools: possible solutions for challenges. *International Journal of Educational Sciences*, 6(2):341-348.

Easton, PB & Moussa, LM. 2019. Literacy usage in impoverished African settings:Post-education for all (EFA) research needs. *International Review of Education,* 65(3):471-496.

Elemam, AE. 2016. Barriers to implementation of information and communication (ICT) in public Sudanese secondary schools: teacher's prospective. *Journal of Sociological Research,* 7(1): 33-43.

EL-Halawany, HSELDM. 2014. New horizons of integrating ICTs in Egyptian initial teacher education, in *Education for a knowledge society in Arabian Gulf countries,* edited by AW Wiseman, NH Alromi & S Alshumrani. Yorkshire: Emerald: 175-198.

Ellis, R. 2004. *Down with boring e-learning*! Interview with e-learning guru Dr Michael with Allen. Learning circuits. [O]. Available:
http://www.astd.org/LC/2004/0704_allen.htm
Accessed on 2018/01/12

Elkins, D & Pinder, D. 2015. *ELearning fundamentals: a practical guide.* Virginia: Association for Talent Development. [O]. Available:
http://0eds.a.ebscohost.com.oasis.unisa.ac.za/eds/ebookviewer/ebook/bmxlYmtfXzEwMjI4NTBfX0FO0?sid=3ee91217a8fa4e81ba41c9b3c26f6d0b@sessionmgr4008&vid=0&format=EK&rid=1
Accessed on 2017/06/09

Els, CJ & Blignaut, AS. 2010. *Exploring teachers' ICT pedagogy in the North-West Province, South Africa* (Paper read at the world conference on educational media and technology, Toronto, Canada, on 29 June 2010).
[O]. Available:
https://www.learntechlib.org/primary/p/34635/
Accessed on 2019/04/12

Ertmer, PA. 1999. Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development,* 47(4): 47-61.

Essel, DD & Wilson, OA. 2017. Factors affecting university students' use of Moodle: an empirical study based on TAM. *International Journal of Information and Communication Technology Education,* 13(1):14-26.

Esselaar, S, Gillwald, A, Moyo, M & Naidoo, K. 2010. Towards evidence-based ICT policy and regulation. *South Africa ICT Sector Performance Review 2009/2010*, 2 (6):1-46.

Eshetu, G. 2015. *Factors affecting instructional leaders' perceptions towards educational media utilisation in classroom teaching*. Hamburg: Anchor.

Etikan, I, Musa, SA & Alkassim, RS. 2016. Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics,* 5(1):1-4.

Eyles, AM. 2018. Teachers' perspectives about implementing ICT in Music education. *Australian Journal of Teacher Education*, 43(5):110-131.

Feldman,R & Zucker, D. Sa. Teaching and learning online. [O]. Available: https://www.umass.edu/oapa/sites/default/files/pdf/handbooks/teaching_and_learning_online_handbook.pdf Accessed on 2018/12/20

Ferri, P. 2012. Digital and inter-generational divide, in *Current trends and future practices for digital literacy and competence*, edited by A Cartelli. Hershey, PA: IGI Global: 1-18.

Ferri, P. 2010. Digital and inter-generational divide. *International Journal of Digital Literacy and Digital Competence,* 1(1): 1-23.

Finn, J & Jacobson, M. 2008. *Just practice: a social justice approach to social work.* Peosta: Eddie bowers.

Fink, A. 2015. *How to conduct surveys: a step-by-step guide*. Ontario: Sage.

Off-grid rural electrification 'pivotal for SA economy'. 2015. *Fin24*, 2 August. [O]. Available: http://www.fin24.com/Economy/Eskom/Off-grid-rural-electrification-pivotal-for-SA-economy-20150802 Accessed on 2017/05/18

Farhadi M, Ismail R & Fooladi, M. 2012. Information and communication technology use and economic growth. *PLoS ONE,* 7(11):1-7. [O]. Available: https://doi.org/10.1371/journal.pone.0048903 Accessed on 2018/07/27

Flick, U. 2007. *Sampling, selecting and access*. London: Sage.

Fong, MWL. 2009. Digital Divide between urban and rural regions in China. *The Electronic Journal on Information Systems in Developing Countries*. EJISDC, 36(6):1-12.

Ford, M, Botha, A & Meraka, CSIR. 2015. Implementation of ICT in rural schools in the Eastern Cape: The ICT4RED Cofimvaba. Pretoria: Council for Scientific and Industrial Research. [O]. Available:
http://www.nstf.org.za/wpcontent/uploads/2015/10/Implementation.pdf
Accessed on 2019/06/01

Foster, V & Briceño-Garmendia, C. 2010. *Africa's infrastructure: a time for transformation*. Washington, DC: The World Bank and Agence Française de Développement.

Fox, B & Twining, P. 2006. *Comparing perspectives on the role of ICT in education* (Paper read at the society for information technology & teacher education international conference, Orlando, Florida, USA on 19 March 2006).
[O]. Available: https://www.learntechlib.org/primary/p/22281/
Accessed on 2018/11/14

Francis, NN, Ngugi, M & Kinzi, J. 2017. Influence of selected factors on the implementation of information and communication technology policy in public secondary schools in Naivasha Sub-county, Kenya. *International Journal of Education and Development using Information and Communication Technology,* 13(2): 70-86.

Fuchs, C. 2008. *Internet and society social theory in the information age*. New York: Routledge.

Fuchs, C & Horak, E. 2008. Africa and the digital divide. *Telematics and Information,* 25(2): 99-116.

Fullan, M & Stiegelbauer, S. 1991. *The new meaning of educational change.* 2nd edition. New York: Teachers College Press.

Friesen, N. 2009. *Re-thinking e-learning research: foundations, methods and practices.* New York: Peter Lang.

García-Peñalvo, FJ. 2014. *Online Tutor 2.0: methodologies and case studies for successful learning: methodologies and case studies for successful learning.* Hershey, PA: IGI Global.

Garcia, JM & Kelly, T. 2016. *The economics and policy implications of infrastructure sharing and mutualisation in Africa.* Washington, DC: The World Bank. [O]. Available:
http://pubdocs.worldbank.org/en/533261452529900341/WDR16-BP-Infrastructure-Mutualisation-Garcia.pdf
Accessed 2018/05/12

Garnham, N. 2005*. Political economy of the information society*. London: Francis & Taylor.

Gerald, L, MacLeod, K, Frost, L & Waller, K.2017. A case study of the integration of information and communication technology in a Northern Ontario First Nation community high school: challenges and benefits*. Journal of International Education Research,* 13(1): 27-34.

Ghavifekr, S, Kunjappan, T, Ramasamy & Anthony, L. 2016. Teaching and learning with ICT tools: issues and challenges from teachers' perceptions. *Malaysian Online Journal of Educational Technology*, 4(2):37-57.

Ghavifekr, S & Rosdy, WAW. 2015. Teaching and learning with technology: effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, 1(2): 175-191.

Gibbs, A. 2013. Focus groups and group interviews, in *Research methods and methodologies in education,* edited by J Arthur, M Waring, R Coe & LV Hedges. Los Angeles: Sage: 186-192.

Giddens, A. 1991. *The consequences of modernity*. Cambridge: Polity Press.

Gill, ML. 2012. *Philosophos: Plato's missing dialogue.* Oxford: Oxford University Press.

Gillham, B. 2010. *Case study research methods*. London: Continuum.

Gillwald, A. 2008. *From Geneva to Tunis to Cairo: how far have we come*? (Paper read at the ITU Africa Telecom, Cairo, Egypt on 12-15 May 2008). [O]. Available: http://www.researchictafrica.net/old/modules.php?op=modload&name=News&file=article&sid=564
Accessed on 2017/02/18

Gillwald, A & Stork, C. 2008. *Towards evidence-based ICT policy and regulation: ICT access and usage in Africa.* Volume one Policy Paper Two. [SI]: ResearchICTAfrica. [O]. Available:
https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/39064/128372.pdf
Accessed on 2019/05/25

Gillwald, A. 2011. South Africa Telecommunications-still a way to go. [SI]: ee publishers. [O]. Available:
http://eepublishers.co.za/article/research-ict-africa.html
Accessed 2017/05/22

Gillwald, A, Moyo, M & Stork, C. 2012. *Understanding what is happening in ICT in South Africa: A supply- and demand side analysis of the ICT sector*. Cape Town: ResearchICTAfrica. [O]. Available:
https://www.researchictafrica.net/publications/Evidence_for_ICT_Policy_Action/Policy_Paper_7_-_Understanding_what_is_happening_in_ICT_in_South_Africa.pdf
Accessed on 2017/05/17

Global System Mobile Association. 2017. *The mobile economy Sub-Saharan Africa.* [O]. Available:
https://www.gsma.com/mobileeconomy/sub-saharan-africa-2017/
Accessed on 2017/09/01

Goad, KD. 2012. *The perception of teachers toward the use of mobile technology as a tool to engage students in learning*. Indiana: Indiana State University. (Doctoral thesis). [O]. Available:
http://scholars.indstate.edu/bitstream/10484/4004/1/Kathryn%20Goad.pdf
Accessed on 2016/03/12

Gonza´lez, C. 2012. The relationship between approaches to teaching, approaches to e-teaching and perceptions of the teaching situation in relation to e-learning among higher education teachers. *An International Journal of the Learning Sciences,* 40(6): 975-998.

Gouldner, AW.1987. Theory and society. *Journal Storage,* 6(2):153-203.

Govender, DG .2012. A model to predict educators' attitudes towards technology and thus technology adoption. *Africa Education Review,* 9(3): 548-568.

Govender, D & Govender, I. 2010. *Educator acceptance of information and communications technology (ICT) integration in teaching and learning in a developing country* (Paper read at the world conference on educational media and technology, Toronto, Canada on 29 June 2010). [O]. Available:
https://www.learntechlib.org/primary/p/34618
Accessed on 2019/01/12

Goyal, L, Purohit, S & Bhagat, M. 2010. Factors that affect information and communication technology usage: a case study in management education. *Journal of Information Technology Management,* 21(4):38-57.

Graham, C. 2006. Blended learning systems, definitions, current trends and future directions, in *The Handbook of Blended Learning: Global Perspectives,* *Local Designs*, edited by CJ Bonk & CR Graham. Pfeiffer, San Francisco, CA: 3-21.

Greenberg, A. 2005. *ICTs for poverty alleviation: basic tool and enabling sector*. Quebec: Sida.

Greene, JC. 2007. *Mixed methods in social inquiry*. San Francisco: Jossey-Bass.

Greene, JC, Caracelli, VJ & Graham, WF. 1989. Toward a conceptual frame-work for mixed-method evaluation design*. Educational Evaluation and Policy Analysis,* 11(3): 255–274.

Groff, J. 2013. *Technology-Rich Innovative Learning Environments.* [SI]: OECD. [O].Available*:* https://www.oecd.org/edu/ceri/TechnologyRich%20Innovative%20Learning%20Environments%20by%20Jennifer%20Groff.pdf
Accessed on 2017/12/07

Grossen, S, Grobler, AA & Lacante, M. 2017. Repeated retention or dropout? Disputing Hobson's choice in South African township schools. *South African Journal of Education,* 37(2):1-11.

Guðmundsdóttir. C. 2005. *Approaching the digital divide in South Africa* (Paper read at the NETREED conference, Beitostølen, Norway on 5-7 Dec 2005}. [O]. Available:
https://www.netreed.uio.no/conferences/conf2005/GretaGudmundsdottir.p
Accessed on 2018/04/17

Guba, EG & Lincoln, YS. 2005. Paradigm controversies, contradictions, and emerging confluences, in *The Sage handbook of qualitative research,* edited by NK Denzin & YS Lincoln. Thousand Oaks, CA: Sage: 191-215.

Guri-Rosenblit, S. 2005. Distance education and e-learning: not the same thing. *Higher Education,* 49(4): 467-493.

Guemide, B & Benachaiba, C. 2012. Exploiting ICT and e-learning in teacher's professional development in Algeria: the case of English secondary school teachers. *Turkish Online Journal of Distance Education*, 13(3): 33-49.

Gunkel, DJ. 2003. Second thoughts: toward a critique of the digital divide, *new media & society,* 5(4):499-522.

Gyamf, A. 2005. Closing the Digital divide in Sub-Saharan Africa: meeting the challenges of the information age. *Information Development,* 21(1):22-30.

Gyamfi, SA. 2017. Pre-service teachers' attitude towards information and communication technology usage: a Ghanaian survey. *International Journal of Education and Development using Information and Communication Technology,* 13(1): 52-69.

Habowski, T & Mouza, C. 2014. Pre-service teachers' development of technological pedagogical content knowledge (TPACK) in the context of a secondary science teacher education program. *Journal of Technology and Teacher Education, 22*(4): 471-495.

Hacker, KL & van Dijk, J (eds). 2000. *Digital democracy: issues of theory and practice*. London: Sage.

Hacker, KL & Mason, SM. 2003. Ethical gaps in studies of the digital divide. *Ethics and Information Technology*, 5(2): 99-115.

Hakami, M. 2014. *Teaching Maths in secondary schools using the IWB: how teacher's knowledge of the affordance of IWB influence teaching practice* (Paper read at the E-learn: world conference on e-learning in corporate, government, healthcare, and higher education conference, New Orleans, United States, on 27-30October2014).[O].Available:
https://www.learntechlib.org/primary/p/149015/
Accessed on 2018/10/12

Hara, N & Kling, R. 2000. Students’ distress with a Web-based distance education course: an ethnographic study of participants’ experiences. *Information, Communication and Society*, 3(4): 557-579.

Harasim, L, Hiltz, SR, Teles, L & Turoff, M. 1995. *Learning networks: a field guide to teaching and learning online*. Cambridge, MA: MIT Press.

Harris, AL & Rea, A. 2009. Web 2.0 and virtual world technologies: a growing impact on IS education. *Journal of Information Systems Education*, 20(2): 137-144.

Harris, JB & Hofer, MJ. 2011. Technological pedagogical content knowledge (TPACK) in action: a descriptive survey of secondary school teachers’ curriculum based- technology related instructional planning. *Journal of Research on Technology in Education,* 43(3): 211-299.

Harrits, GS. 2011. More than method? A discussion of paradigm differences within mixed methods research. *Journal of Mixed Methods Research,* 5(2):150-166.

Harris, P, Connolly, J & Feeney, L. 2009. Blended learning: overview and recommendations for successful implementation. *Industrial and Commercial Training,* 41(3): 155-163.

Hargittai, E. 2002. Second-level digital divide: differences in people's online skills. [O]. Available:https://firstmonday.org/article/view/942/864 Accessed on 2018/09/21

Hargittai, E. 2005. Survey measures of web-oriented digital literacy. *Social Science Computer Review*, (23):371-379.

Hart, SA & Laher, S. 2015. Perceived usefulness and culture as predictors of teachers’ attitudes towards educational technology in South Africa. *South African Journal of Education,* 35(4):1-14.

Hawthorne, R. 2015. Economic regulation of the telecommunications sector in South Africa. *The African Journal of Information and Communication,* 2015(14): 20-37.

Hawthorne, R. 2016. The impact of the call termination rate reduction on consumer surplus in South Africa. *The African Journal of Information and Communication,* 17(2016): 199-207.

Henning, E, van Rensburg, W & Smit, B. 2004. *Finding your way in qualitative research*. Pretoria: Van Schaik.

Hennink, MM. 2007. *International focus group research: a handbook for the health and social sciences.* Cambridge: Cambridge University Press.

Hindman, DB. 2000. The rural-urban digital divide*. Journalism and mass communication quarterly,* 77(3):549-560.

Hlagala, AR. 2015. *Mobile educational technologies currently used as a means to enhance teaching and learning in a privileged high school.* Pretoria: University of South Africa. (Masters Dissertation).

Hodge, J. 2000. Liberalising communication services in South Africa*. Development Southern Africa,* 17(3):373-387.

Hoffman, DL, Novak, TP & Chatterjee, P. 1995. Commercial scenarios for the web: opportunities and challenges. *Journal of Computer-Mediated Communication, Special Issue on Electronic Commerce*, 1(3):21-25.

Hohenthal, J, Owidi, E, Minoia, P & Pellikka, P. 2015. Local assessment of changes in water-related ecosystem services and their management: DPASER conceptual model and its application in Taita Hills, Kenya. *International Journal of Biodiversity Science, Ecosystem Services & Management,* 11(3):1-14.

Holmner, M & Britz, JJ. 2013. When the last mile becomes the longest mile: a critical reflection on Africa's ability to transform itself to become part of the global knowledge society. *Journal of appropriate librarianship and information work in Southern Africa,* (46):117-134.

Holmes, B & Gardner, J. 2006. *E-learning: concepts and practice*. London: Sage.

Holmes, D. 2005. *Communication theory: media, technology, society*. London: Sage.

Holzer, M & Manoharan, A. 2009. Tracking the digital divide: studying the association of the global digital divide with societal divide, in *E-government development and diffusion: inhibitors and facilitators of digital democracy,* edited by G Sahu, Y Dwivedi & V Weerakkody. Hershey, PA: IGI Global: 54-65.

Hongladarom, S. 2009. Global digital divide, global justice, cultures, and epistemology, in *Selected readings on global information technology: contemporary applications*, edited by H Rahman. Hershey, PA: IGI Global: 37-50.

Horrigan, J & Rainie, L. 2002. The broadband difference: How online behavior changes with highspeed Internet connections. Washington, DC: Pew Internet and American Life Project.

Horwitz, RB & Currie, W. 2007. Another instance where privatisation trumped liberalisation: the politics of telecommunications reform in South Africa-politics of telecommunications reform in South Africa- a ten year retrospective. *Telecommunications Policy,* 31(98-9): 445-462.

How South Africa is connected to the global Internet. 2014. *My broadband*, 5 June. [O]. Available:
https://mybroadband.co.za/news/telecoms/103701-how-south-africa-is-connected-to-the-global-internet.html
Accessed on 2017/09/29

Ho, C & Tseng, S. 2006. From digital divide to digital inequality: the global perspective. *International Journal on Internet and Enterprise Management*, 4(3):215-227.

Huber, SG. 2004. School leadership and leadership development. *Journal of Educational Administrative,* 42(6): 669-684.

Human Science Research Council. 2012. *Highlights from TIMSS 2011: the South African perspective*. [O]. Available: http://www.hsrc.ac.za/uploads/pageContent/2929/TIMSSHighlights2012Dec7final.pdf Accessed on 2018/01/04

Husing, T & Selhofer, H. 2002. *The digital divide index - a measure of social inequalities in the adoption of ICT* (Paper read at the 10th European conference on information systems, Gdansk, Poland on 6 – 8 June 2002).

Huynh, M. 2005. Viewing e-learning productivity from the perspective of Habermas' cognitive interests theory. *Journal of Electronic Commerce in Organizations*, 3(2): 33-45.

Hyde-Clark, N & Van Tonder, T. 2011. Revisiting the 'Leapfrog' debate in light of current trends of mobile phone internet usage in the greater Johannesburg area, South Africa. *Journal of African Media Studies*, 3(2):263-276.

Ibrahim, Y. 2009. Contemporary Concerns of Digital Divide in an Information Society, in *Encyclopedia of information science and technology,* edited by M Khosrow-Pour. Hershey, PA: IGI Global: 722-727.

Idowu, AI & Esere, M. 2013. ICT and higher educational system in Nigeria. *Academic journals,* 8(21): 2021-2022. Infrastructuration. 2007. *South Africa 2003-04: two economies?* [O]. Available:
http://infrastructuration.blogspot.co.za/2007/04/south-africa-2003-04-two-economies.html
Accessed on 2017/05/17

Igun, S. 2013. Bridging of digital divide in Africa, in *Learning tools and teaching approaches through ICT advancements,* edited by L Tomei. Hershey, PA: IGI Global: 338-347.

International Labour Organisation. 2001. The digital divide: employment and development implications. *International Labour Review*, 140(2):113-115.

International Telecommunication Union. 2006. *World information society report.* Geneva: ITU. [O]. Available:
https://www.itu.int/osg/spu/publications/worldinformationsociety/2006/wisr-web.pdf Accessed on 2019/08/06

International Telecommunication Union. 2006*. World summit on the information society*. Geneva 2003-Tunis 2005. Geneva: ITU. [O]. Available:
https://www.itu.int/net/wsis/participation/index.html
Accessed on 2019/05/30

International Telecommunication Union. 2011. *Measuring the information society*. Geneva: ITU. [O]. Available:
https://www.itu.int/net/pressoffice/backgrounders/general/pdf/5.pdf
Accessed on 209/07/13

International Telecommunication Union. 2012. *Key statistical highlights: ITU data release June 2012.*Geneva: ITU. [O]. Available:
http://www.itu.int/ITUD/ict/statistics/material/pdf/2011%20Statistical%20highlights_June_201 2.pdf
Accessed on 2016/03/11

International Telecommunication Union .2012. *Report on the state of broadband 2012: achieving digital inclusion for all*. New York: UN. The broadband commission. [O]. Available:
http://www.broadbandcommission.org/Documents/bbannualreport2012.pdf
Accessed on 2018/04/12

International Telecommunication Union. 2012. *Measuring the Information Society*. Geneva: ITU.
[O]. Available:
http://www.itu.int/ITUD/ict/publications/idi/material/2012/MIS2012_without_Annex_4.pdf
Accessed on 2018/02/10

International Telecommunication Union. 2014. *Manual for measuring ICT access and use by households and individuals.* Geneva: ITU. [O]. Available:
www.itu.int/dms_pub/itu-d/opb/.../D-IND-ITCMEAS-2014-PDF-E.pdf
Accessed on 2018/07/10

International Telecommunication Union. 2015. *The world in 2015 ICT facts & figures.* Geneva: ITU. [O]. Available:
https://www.itu.int/en/ITUD/Statistics/.../facts/ICTFactsFigures2015.pdf
Accessed on 2018/06/27

International Telecommunication Union Information and Communication Technology Development Index. 2015. *South Africa*. Geneva: ITU. [O]. Available:
http://www.itu.int/net4/ITU-D/idi/2015/#idi2015countrycard-tab&ZAF
Accessed on 2018/05/09

International Telecommunication Union Information and Communication Technology Development Index. 2015*. Global ICT development index.* Geneva: ITU. [O]. Available:
http://www.itu.int/net4/ITU-D/idi/2015/
Accessed on 2018/07/26

International Telecommunication Union and United Nations Educational, Scientific and Cultural Organisation. 2015. *The state of broadband 2015: broadband as a foundation for sustainable development.* Geneva: ITU. [O]. Available:
http://www.broadbandcommission.org/documents/reports/bbannualreport2015.pdf
Accessed on 2018/06/12

International Telecommunication Union. 2016. *Information and communication technology statistics*. Geneva: ITU. [O]. Available:
https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
Accessed on 2018/03/06

International Telecommunication Union. 2016. *Achieving equitable communication for everyone.* Geneva: ITU. [O]. Available:
https://www.itu.int/en/action/accessibility/Pages/default.aspx
Accessed on 2018/03/10

International Telecommunication Union. 2017. *ICT facts and figures.* Geneva: ITU. [O]. Available:
https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf
Accessed on 2018/07/05

International Telecommunication Union. 2017. *Measuring the information society report volume 1.* Geneva: ITU. [O]. Available:
https://www.itu.int/en/ITUD/Statistics/Documents/publications/misr2017/MISR2017_Volume1.pdf
Accessed on 2018/07/05

IST-Africa. [Sa]. Current ICT Initiatives and projects- Republic of South Africa. [O]. Available:
http://www.ist-africa.org/home/default.asp?page=doc-by-id&docid=3574
Accessed on 2018/12/10

Isaacs, S. 2007. *Survey of ICT and Education in Africa: South Africa Country Report.* Washing, DC: The World Bank. [O]. Available:
http://www.infodev.org/infodevfiles/resource/InfodevDocuments_429.pdf
Accessed on 2018/06/10

Isaac, S. 2012. *Mobile learning for teachers in Africa and Middle East: Exploring the potential of mobile technologies to support teachers and improve practice*. Paris: UNESCO. [O]. Available:

https://unesdoc.unesco.org/ark:/48223/pf0000216358
Accessed on 2019/02/13

Informa Telecoms News Archive. 2015. *ITWeb,* 16 November. [O]. Available: http://www.itweb.co.za/?tag=Informa+Telecoms
Accessed on 2017/05/18

Jacobs, A. 2011. Using mobile devices to increase student engagement. *Educator Resources: Teaching Tips, Tools & Articles* Charlotte, NC: Knight Communications. [O]. Available:
http://seenmagazine.us/articles/article-detail/articleid/1803/using-mobiledevices-to-increase-student-engagement.aspx
Accessed on 2018/04/09

Jaffer, S, N'gambi, D, & Czerniewicz, L. 2007. The role of ICTs in higher education in South Africa: one strategy for addressing teaching and learning challenges. *International Journal of Education and ICT,* 3(4):131-142.

Jaipal, JK & Figg, C. 2010. A case study of a TPACK-based approach to teacher professional development: teaching science with blogs. *Contemporary Issues in Technology and Teacher Education,* 15(2):161-200.

James, J. 2003. Re-estimating the difficulty of closing the digital divide. *Journal of the American Society for Information Science and Technology*, 59(12):2012-2024.

James, N .2008. Authenticity, in *The sage encyclopaedia of qualitative research methods*, edited by LM Given. Calif: Sage: 40.

Jang, SJ & Tsai, MF. 2013. Exploring the TPACK of Taiwanese secondary school science teachers using a new contextualized TPACK model. *Australasian Journal of Educational Technology*, 29(4):566-580.

Jayson, RW, Nash, JB & Flora, KL. 2014. Unsystematic technology adoption in Cambodia: students' perceptions of computer and internet use. *International*

Journal of Education and Development using Information and Communication Technology, 10(2): 63-76.

Jenkins, M & Hanson, J. 2003. E-learning series: a guide for senior managers, learning and teaching support network (LSTN) Generic Centre, United Kingdom.

Jensen, D. 2008. Access, in *The Sage encyclopaedia of qualitative research methods*, edited by LM Given. Calif: Sage: 44-45.

Jick, TD. 1979. Mixing qualitative and quantitative methods: triangulation in action. *Administrative Science Quarterly,* 24(4): 602-611.

Johannes, SD. 2007. *Teaching and learning entrepreneurship Online in Soshanguve Technical high school: a case study* (Paper read at the world conference on educational multimedia, hypermedia & telecommunications, Vancouver, Canada on 25 June 2007).
[O]. Available:
https://0-www.learntechlib.org.oasis.unisa.ac.za/p/25684/
Accessed 2017/10/01

Jonscher, C.1999. *Wired life*. New York: Bantam.

Jonscher, C.1983. Information resources and economic productivity. *Information Economics and Policy,* 1(1):13-35.

Johnson, RB & Onwuegbuzie, AJ & Turner, LA. 2007. Toward a definition of mixed methods research. *Journal of Mixed Methods Research,* 1(2): 112-133.

Julien, H. 2016. Beyond the hyperbole: information literacy reconsidered. *Communications in Information Literacy,* 10(2): 124-131.

Kabe, T, Kalema, B & Motjolopane, I. 2015. *E-learning acceptance by secondary schools educators in South Africa* (Paper read at the AACE world conference on e-learning in corporate, government, healthcare, and higher education, Kona, Hawaii, USA on 19 October 2015).

[O]. Available:
https://0-www.learntechlib.org.oasis.unisa.ac.za/p/161822/
Accessed on 2017/09/20

Kafyulilo, A, Fisser, P & Voogt, J. 2013. *Supporting teachers' collaboration in design teams to develop technological pedagogical content knowledge: the case of science teachers in Tanzania* (Paper read at the society for information technology & teacher education international conference, New Orleans, Louisiana, USA on 25 March 2013). [O]. Available:
https://research.utwente.nl/en/publications/supporting-teachers-collaboration-in-design-teams-to-develop-tech
Accessed on 2018/04/12

Kang, M, Heo, H & Kim, M. 2011. The impact of ICT use on new millennium learners' educational performance. *Interactive Technology and Smart Education*, 8(1): 18-27.

Kassam, A, Iding, M & Hogenbirk, P. 2013. Unraveling the digital divide: time well spent or "wasted"? *Educational and Information Technologies,* 18(2): 215-221.

Kalanda, K & De Villiers, R. 2008. *Toward ICT integration in the science classroom: a comparative study of cases in Lesotho and South Africa* (Paper read at the world conference on educational media and technology, Vienna, Austria on 30 June 2008).
[O]. Available:
https://0-www-learntechlib-org.oasis.unisa.ac.za/primary/p/28823/
Accessed on 2017/12/17

Kalanda, K & De Villiers, MR. 2013. *E-Learning in the Science curriculum: a study in selected high schools in Lesotho* (Paper read at the world conference on educational media and technology, Victoria, Canada on 24 June 2013). [O]. Available:
https://0-www-learntechlib org.oasis.unisa.ac.za/primary/p/112189/
Accessed on 207/11/02

Kalolo, JF. 2015. The drive towards application of pragmatic perspective in educational research: opportunities and challenges. *Journal of Studies in Education,* 5(1):150-171.

Kafyulilo, A, Fisser, P & Voogt, J. 2012. *Transforming classroom practices through teachers' learning of TPACK: the case of in-service teachers at Kibasila secondary school in Tanzania* (Paper read at the society for information technology & teacher education international conference, Austin, Texas, USA on 05 March 2012). [O]. Available:
https://0-www-learntechlib-org.oasis.unisa.ac.za/primary/p/40023/
Accessed on 2017/12/24

Katz, RL. 2012. *Impact of broadband on the economy*. Geneva: ITU. [O]. Available:
www.itu.int/broadband
Accessed on 2017/11/12

Katz, JE & Rice, RE. 2002. *Social consequences of internet use: access, involvement and interaction.* Cambridge: MIT Press.

Kaye, HS. 2000. *Computer and internet use among people with disabilities: disability statistics report.* Washington, DC: National Institute on Disability and Rehabilitation Research. [O]. Available:
http://www.akmhcweb.org/Docs/computerREPORT13.pdf
Accessed on 2017/03/19

Keller, D. 2006. *New technologies and alienation: some critical reflection*. Maryland: Rowman and Littlefield.

Kelly, K. 1988. *New rules for the new economy: ten ways the networking economy is changing everything*. London: Fourth Estate.

Keniston, K. 2001. Language, power and software. New York: Sunny Press.

Kereluik, K, Mishra, P & Koehler, MJ. 2010. On learning to subvert signs: literacy, technology and the TPACK framework. *California Reader,* 44(2):12-18.

Kertzer, DI & Fricke, T.1997. *Toward an anthropological demography. Anthropological demography: toward a new synthesis.* Chicago: University of Chicago Press.

Keser, H, Yılmaz, FGK & Yılmaz, R. 2015. TPACK competencies and technology integration self-efficacy perceptions of pre-service teachers. *Elementary Education Online*, 14(4):1193-1207.

Khan, SH, Hasan, M & Clement, CK. 2012. Barriers to the introduction of ICT into education in developing countries: the example of Bangladesh. *International Journal of Instruction*, 5(2): 61-80.

Kim, Y, Kelly, T & Raja, S. 2010. *Building broadband: Strategies and policies for the developing world*. Washington, DC: The World Bank. [O]. Available: https://openknowledge.worldbank.org/handle/10986/2469
Accessed on 2018/03/12

King, MB & Newman, FM. 2001. Building school capacity through professional development: conceptual and empirical considerations. *The International Journal of Educational Management,* 15(2):86-94.

Kiriakidis, P & Jenkins-Williams, E. 2013. A case study of mentor-to-mentee program to help African males graduate from high school. *Postmodern Openings Journal*, (4): 81-93.

Koehler, MJ, Mishra, P, Akcaoglu, M & Rosenberg, JM. 2013. Technological pedagogical content knowledge for teachers and teacher educators, in *ICT integrated teacher education: a resource book*, edited by N Bharati & S Mishra. New Delhi: Commonwealth Educational Media Center for Asia: 1-8.

Koehler, M & Mishra, P. 2009. What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education,* 9(1): 60-70.

Koh, J. 2013. A rubric for assessing teachers' lesson activities with respect to TPACK for meaningful learning with ICT. *Australasian Journal of Educational Technology,* 29(6): 887-900.

Koh, JHL, Chai, CS, Hong, HY & Tsai, CC. 2015. A survey to examine teachers' perceptions of design dispositions, lesson design practices, and their relationships with technological pedagogical content knowledge (TPACK). *Asia-Pacific Journal of Teacher Education,* 43(5): 378–391.

Koss, F. 2001. Children falling into the digital divide. *Journal of International Affairs,* 55(1):75–92.

Kotecha, P. 2010. 'Dazzling technologies': addressing the digital divide in the Southern African universities. *The African journal of information and communication,* 3(10): 53-66.

Kothari, CR. 2004. *Research methodology: methods and techniques*. 2nd edition. New Delhi: New Age.

Kuada, JE. 2012. *Research methodology: a project guide for university students*. Frederiksberg: Samfundslitteratur.

Kubicek, H. 2004. Fighting a moving target. *IT & Society,* 1(6): 1-19.

Kwinana, A (ed). 2017. *Our vision for South African education*. Johannesburg: Kagiso Trust and the University of Johannesburg. [O]. Available: https://www.uj.ac.za/faculties/facultyofeducation/Documents/Education-Conversations-Visions-Booklet-2017.pdf
Accessed on 2017/01/04

Kwofie, B & Henten, A. 2011. The advantages and challenges of e-learning implementation: the story of a developing nation (Paper read at the WCES-3RD World Conference on Educational Sciences, Istanbul, Turkey on 13-14 2011).

Kyobe, M. 2011. Investigating the key factors influencing ICT adoption in South Africa. *Journal of Systems and Information Technology,* 13(3): 255-267.

Kroukamp, H. 2005. E-governance in South Africa: are we coping? *Acta Academia,* 37(2): 52-69.

Ladyshewsky, R & Taplin, R. 2014. Leadership development using three modes of educational delivery: online, blended and face to face. *International Journal on E-Learning, 13*(3): 273-290.

Ladyshewsky, R. 2004. E-learning compared with face to face: Differences in the academic achievement of postgraduate business students. *Australasian Journal of Educational Technology*, 20(3): 316-336.

Lamb, S & Markussen, E (eds). 2011. *School dropout and completion: an international perspective*. New York: Springer.

Lang, M & Costello, M. 2009. *An investigation of factors affecting satisfactory student learning via on-line discussion boards* (Paper read at the m-ICTE2009 conference Lisbon, Portugal on 22-24 April 2009). [O]. Available:
https://aran.library.nuigalway.ie/handle/10379/268
Accessed on 2017/08/26

Lateh, H & Muniandy. 2016. ICT implementation among Malaysian schools: GIS, obstacles and opportunities. *Procedia-Social and Behavioural Sciences,* 2(2):2846-2850.

Lauver, KL, Drum, DM, Windsor, JM & Miller, SM. 2013. Preference of education mode: examining the reasons for choosing and perspectives of courses delivered entirely online. *Journal of Applied Research in Higher Education,* 5(1): 113-128.

Lautenbach, G. 2010. *A cross sectional survey to explore the e-maturity of schools in Gauteng Province, South Africa* (Paper read at the *ED-MEDIA 2010*-world conference on educational media and technology, Toronto, Canada on 29 June 2010).
[O]. Available:
https://0-www-learntechlib-org.oasis.unisa.ac.za/primary/p/34876/
Accessed on 2017/05/12

Lauver, KJ, Drum, DM, Windsor, JM & Miller, SM. 2013. Preference of education mode: examining the reasons for choosing and perspectives of courses delivered entirely online. *Journal of Applied Research in Higher Education*, 5(1): 113-128.

Law, N, Pelgrum, WJ & Plomp, T (eds). 2008. *Pedagogy and ICT use in schools around the world: findings from the IEA SITES 2006 Study.* The University of Hong Kong: Springer.

Leadbeater, C. 1999. *Living on thin air: the new economy*. London: Viking.

Leech, N & Onwuegbuzie, A. 2008. Debriefing, in *The SAGE encyclopaedia of qualitative research methods*, edited by LM Given. Thousand Oaks: CA: Sage: 200-2001.

Leech, NL & Onwuegbuzie, AJ. 2009. A typology of mixed methods research designs: quality & quantity. *International Journal of Methodology*, 43(2): 265-275.

Leedy, PD & Ormrod, JE. 2005. *Practical Research Planning and Design*. 9th edition. New Jersey: Pearson.

Leendertz, V, Blignaut, S, Niewoudt, H, Els, CJ & Ellis, SM. 2013. Technological pedagogical content knowledge in South African mathematics classrooms: a secondary analysis of SITES 2006 data. *Pythagoras,* 34(2):37-45.

Lesame, NC, Mbatha, B & Sindane, S. 2011. *New media in the information society*. Pretoria: Van Schaik.

Lesame, NC. 2013. Vision and practice: the South African information society experience. *Journal of Multidisciplinary Research,* 5(1): 73-90.

Lesame & Seti. 2014. Technology access centres and community development: the case of the Eastern Cape Province in South Africa. *Mediterranean Journal of Social Sciences,* 5(10):303-317.

Liao, H & Lu, H. 2008. Richness versus parsimony antecedents of technology adoption model for e-learning websites, in *Advances in web based learning*, edited by F Li, J Zhao, Tk Shih, R Lau, Q Li & D Mcleod. Berlin, Heidelberg: Springer: 121-134. [O]. Available:
http://Dx.Doi.Org/10.1007/978-3-540-85033-52
Accessed on 2017/10/16

Liaqat, A. 2018. The influence of information technology on student's behavioural nature in the class room. *Asian Journal of Education and Training*, 4(2):102-107.

Lievrouw, LA & Livingstone, S (eds). 2010. *Handbook of new media: social shaping and social consequences of ICTs*. London: Sage.

Lin, CIC, Tang, W & Kuo, FY. 2012. Mommy Wants to Learn the Computer: how middle-aged and elderly women in Taiwan learn ICT through social support. Adult *Education Quarterly*, 62(1):73-90.

Lincoln, YS & Guba, EG. 1985. *Naturalistic inquiry*. Boston: Sage.

Lopes, AP. 2014. *Learning management systems in higher education* (Paper read at the 6th international conference on education and new learning technologies, Barcelona, Spain on 7-9 July 2014). [O]. Available:
https://library.iated.org/publications/EDULEARN14
Accessed on 2017/03/12

Lopez-Pe´rez, MV, Pe´rez-Lopez, MC & Rodrı´guez-Ariza, L. 2011. Blended learning in higher education: students' perceptions and their relation to outcomes. *Computers and Education*, 56(3): 818-826.

Lu, J & Price, J. 2018. Chinese students' ICT readiness for a blended teaching and learning environment. *Journal of Mathematics, Science and Technology Education*, 14(7):2907-2914.

Lundall, P & Howell, C. 2008. A national survey of information communication technology in South African schools. Cape Town: Education Policy Unit, University of the Western Cape and the International Development Research Centre.

Lyon, D. 1988.*The information society: issues and illusions*. Cambridge: Polity Press.

Lyublinskaya, I & Tournaki, N. 2014. A study of special education teachers' TPACK development in mathematics and science through assessment of lesson plans. *Journal of Technology and Teacher Education,* 22(4): 449-470.

Macnee, LC & McCabe, S. 2008. *Understanding nursing research: using research evidence-based practice.* Philadelphia, PA: Lippincott Williams & Wilkins.

Macupe, B & Hawker, D. 2012. Poor facilities cripple teaching. *Independent Online*, 24 June. [O]. Available:
https://www.iol.co.za/news/south-africa/eastern-cape/poor-facilities-cripple-teaching-1326099
Accessed on 2017/10/04

Macupe, B. 2017. Laptops just ornaments for Eastern Cape teachers who are not trained to use them. *Mail & Guardian*, 5 October. [O]. Available:
https://mg.co.za/article/2017-10-05-00-laptops-are-ornaments-teachers
Accessed on 2017/10/05

Machlup, F.1962. *The production and distribution of knowledge in the United States*. Princeton, NJ: Princeton University Press.

Mafurag, M & Moremi, M. 2017. Integrating information and communication technology in English language teaching: a case study of selected junior secondary schools in Botswana. *International Journal of Education and Development using Information and Communication Technology,* 13(1): 142-152.

Magwedze, H & Nocolaides, G. 2016. Lack of qualifications, experience among teachers 'a problem'. *Eye Witness News*. [O]. Available:
http://ewn.co.za/2017/01/05/lack-of-qualifications-experience-among-teachers-a-problem
Accessed on 2017/10/05

Makhubu, N. 2014. Gauteng MEC aims for paperless schools. *IOL News*, 10 June. [O]. Available:
https://www.iol.co.za/news/south-africa/gauteng/gauteng-mec-aims-for-paperless-schools-1701018
Accessed on 2019/07/27

Mamabolo, M. 2017. Africa edges closer to 1bn mobile subscriptions. *ITWEB Africa*, 23 June. [O]. Available:
http://www.itwebafrica.com/mobilex/339-africa/238062-africa-edges-closer-to-1bn-mobile-subscriptions
Accessed on 2019/05/25

Mangeni, S, Hamdounm, H, Ennser, K & Miburu, J. 2013. Sustainable green broadband solutions for bridging the digital divide in Africa: A technical survey of feasible and affordable broadband solutions for rural Africa. *IEEE Africon,* 4(3):1-5.

Marcovitz, DM. 2015. Changing schools with technology: what every school should know about innovation. *Technology and Education: Issues in Administration, Policy, and Applications,* 2(8):3-15. [O]. Available:
http://www.loyola.edu/school-education/faculty/david-marcovitz
Accessed on 2017/06/12

Martin, WJ. 1988. The information society-idea or entity? *Aslib Proceedings,* 40 (11/12): 303-309. [O]. Available:

https://doi.org/10.1108/eb051115
Accessed on 2017/04/12

Maksimovic, J & Dimic, N. 2016. Digital technology and teachers' competence for its application in the classroom. *Research in Pedagogy*, 6(2): 59-71.

Mason, R & Rennie, F.2006. *Elearning: the key concepts*. New York: Routledge.

Mason, MK. 2011. Potential of information and communication technologies (ICTs) for developing countries. [O]. Available:
http://www.moyak.com/papers/ngo-icts.html Accessed on 2018/04/28

Masondo, S. 2011. Gauteng spends on education, health. *The times,* 2 March. [O].Available:
http://infoweb.newsbank.com/resources/doc/nb/news/135bb0c75379b3d8?p=asanb
Accessed on 2015/08/14

May, T. 2011. *Social research: issues, methods and process*. Maidenhead, Berkshire: McGraw-Hill.

Mathiyazhagan, T & Nandan, D. 2010. Survey research method. *Media Mimansa*, 4 (1): 34-45.

McLoughlin, C Lee, MJW. 2010. Personalized and self-regulated learning in the Web 2.0 era: international exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology*, 26(1): 28-43.

McLuhan, M. 1968. *To understand the media: the technological extensions of man*. Paris: Threshold.

Meagre spending on health, education ICT. 2015. *ITWeb*, 19 August. [O].Available:
http://infoweb.newsbank.com/resources/doc/nb/news/15751FE9E88C2850?p=ASANB

Accessed on 2015/12/28

Mei Lick Cheok, J & Su Luan Wong, W. 2015. Predictors of e-learning satisfaction in teaching and learning for school teachers: a literature review. *International Journal of Instruction,* 8(1): 75-90.

Mertens, DM. 2010. *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*, 3rd edition. Thousand Oaks, CA: Sage.

Menter, I, Elliot, D, Hulme, M, Lewin, J & Lowden, K. 2011. *A guide to practitioner research in education*. Los Angeles: Sage.

Millson, M & Wilemon, D. 2008. Educational quality correlates of online graduate management education. *Journal of Distance Education*, 22(3): 1-18.

Mikre, F. 2011. The roles of information communication technologies in education. *Ethiopian Journal of Education and Sciences,* 6(2):1-16.

Min, SJ. 2010. From the digital divide to the democratic divide: internet skills, political interest, and the second-level digital divide in political internet use. *Journal of Information Technology & Politics,* 7(1): 22-35.

Mingaine, L. 2013. Challenges in the implementation of ICT in public secondary schools in Kenya. *International Journal of Social Sciences & Education,* 4(1):2223-4934.

Mishra, L. 2016. Focus group discussion in qualitative research. *An International Journal of Educational Technology*, 6(1):1-5.

Mishra, P & Koehler, MJ. 2006. Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record,* 108(6): 1017-1054.

Mkhize, P, Mtsweni, S & Buthelezi, P. 2016. Diffusion of innovations approach to the evaluation of learning management system usage in an open distance learning institution. *International Review of Research in Open and Distributed Learning*, 17(3): 295-312.

Mobile phones are transforming Africa. 2016. *The Economist,* 10 December. [O]. Available:
https://www.economist.com/middle-east-and-africa/2016/12/10/mobile-phones-are-transforming-africa
Accessed on 2017/11/26

Modisaotsile, MB. 2012. The falling standard of basic education in South Africa. Africa Institute of South Africa policy briefing no 72. UKZN.

Moeller, B & Reitzes, T. 2011. Integrating technology with student-centered learning. *A report to the Nellie Mae education foundation*. Quincy, MA: The Nellie Mae Education Foundation. [O]. Available:
www.nmefdn.org
Accessed on 2016/11/27

Molawa, S. 2009. *The first and third world in Africa: knowledge, access, challenges and current technological innovations* (Paper read at the first international conference on African digital libraries and archives (ICADLA-1), Addis Ababa, Ethiopia on 1- 3 July 2009). [O]. Available:
https://core.ac.uk/download/pdf/39667850.pdf
Accessed on 2017/02/15

Molina, A. 2003. The digital divide: the need for a global e-inclusion movement. *Technology Analysis & Strategic Management,* 15(1): 137-152.

Moore, JL, Dickson- Deane, C & Gaylen, K. 2011. E-Learning, online learning, and distance learning environment: are they the same? *Internet and the Higher Education,* 14(2): 129-135.

Moore, N. [Sa]. *The information society*. [O]. Available:
http://www.unesco.org/webworld/wirerpt/wirenglish/chap20.pdf
Accessed on 2017/01/18

Morgan, DL. 2002. Focus group interviewing, in *Handbook of interviewing research: Context & method,* edited by JF Gubrium & JA Holstein. Thousand Oaks, CA: Sage: 141-159.

Morgan, DL. 2007. Paradigms lost and pragmatism regained. *Journal of Mixed Methods Research*, 1(1): 48-76.

Mossberger, K, Tolbert, CJ & Hamilton, A. 2012. Measuring digital citizenship: mobile access and broadband. *International Journal of Communication,* 6(2012):2492-2528.

Mohamed, BM & Joanna, S. 2017. Digital gender divides and e-empowerment in the UAE: a critical perspective. *International Journal of Education and Development using Information and Communication Technology*, 13(3):145-161.
Mouton, J. 1996. *Understanding social research*. Pretoria: van Schaik.

Mustafina, A. 2016. Teachers' attitudes toward technology integration in a Kazakhstani secondary school. *International Journal of Research in Education and Science,* 2(2): 322-332.

Muslem, A, Yusuf, YQ & Rena, J. 2018. Perceptions and barriers to ICT use among English teachers in Indonesia. *Teaching English with Technology*, 18(1): 3-23.

Mutula, SM .2005. Peculiarities of the digital divide in Sub-Saharan Africa*. Electronic Library and Information Systems,* 39(2):122- 138.

Mutula, SM. 2008. Digital divide and economic development: case study of Sub-Saharan Africa. *The Electronic Library,* 26(4): 468-489. [O]. Available: http://dx.doi.org/10.1108/02640470810893738
Accessed on 2017/03/10

Mugimu, CB. 2010. The state of higher education in Africa. *Comparative & International Higher Education,* 3(1):5-6.

Mulas, V. 2012. *Policies for mobile broadband.* Washington, DC: The World Bank.

Mulwa, A & Kyalo, D. 2013. The influence of principals', teachers' and students' attitude on readiness to adopt e-learning in secondary schools in Kitui district, Kenya. *European Scientific Journal*, 9(5): 183-202.

Mutume, G. 2003. Africa takes on the digital divide. *Africa Recovery*, 17(3):1-11. [O]. Available:
http://www.un.org/en/africarenewal/vol17no3/173tech.htm
Accessed on 2017/04/12

Mzekandaba, S. 2015. Teacher Laptop Initiative News Archive. *ITWeb,* 12 October. [O]. Available:
http://www.itweb.co.za/?tag=Teacher+Laptop+Initiative
Accessed on 2017/06/16

Nardi, BA & O'Day, V. 1998. Information ecologies. *Reference and User Services Quarterly,* 38(1): 48-58.

Naidoo, G. 2012. Implementation of E-government in South Africa - successes and challenges: the way forward. *International Journal of Advances in Computing and Management,* 1(1): 62-66.

Narayan, G. 2007. Addressing the digital divide: e-governance and m-governance in a hub and spoke model. *The Electronic Journal of Information Systems in Developing Countries,* 31(1): 1-14.

Nath, HK. 2009. The Information Society- SIBCOLTEJO. *A Journal of the SCTU,* 2(4):19-29.

Nawaz, A. 2013. Using e-learning as a tool for 'education for all' in developing states. *International Journal of Science and Technology* Education Res*earch,* 4(3): 38-46.

Ncube, M, Charles, C & Lufumpa, L. 2017. *Infrastructure in Africa: lessons for future development.* Bristol: Policy Press.

Negash, S, Wilcox, MV & Emerson, M. 2007. Synchronous hybrid e-learning: teaching complex information systems classes online. *International Journal of Information and Communication Technology Education,* 3(3): 1-13.

Negroponte, N. 1995. *Being Digital*. New York: Alfred A. Knopf.

Neiss, M, Driskell, S & Hollebrands, K. 2016. *Handbook of research on transforming Mathematics teacher education in the digital age*. Hershey PA: Information science.

Niess, ML, Ronau, RN, Shafer, KG, Driskell, SO, Harper, SR, Johnston, C, Browning, C, Özgün-Koca, SA, & Kersaint, G. 2009. Mathematics teacher TPACK standards and development model. *Contemporary Issues in Technology and Teacher Education,* 9(1):4-24.

Niess, ML, van Zee, EH & Gillow-Wiles, H. 2011. Knowledge growth in teaching Mathematics/Science with spreadsheets: moving PCK to TPACK through online professional development. *Journal of Digital Learning in Teacher Education*, 27(2):42-52.

Neuman, LW. 2006. *Social research methods: qualitative and quantitative approaches*. 6th edition. Boston: Pearson Education.

Neuman, LW. 2011. *Basics of social research: qualitative and quantitative approaches.* New York: Prentice Hall.

Neuman, LW. 2013. *Basics of social research: Pearson new international edition.* London: Pearson.

Ng, W & Nicholas, H. 2013. A framework for sustainable mobile learning in schools. *British Journal of Educational Technology,* 44(5):695-715.

Ngoungouo, A. 2017. The use of ICTs in the Cameroonian school system: a case study of some primary and secondary schools in Yaoundé. *International Journal of Education and Development using Information and Communication Technology,* 13(1):153-159.

Ngqakamba, S. 2019. State-of-the-art Tsakane school robbed of tablets, laptops, TV and cash. *News 24,* 15 January. [O]. Available:
https://www.news24.com/SouthAfrica/News/state-of-the-art-tsakane-school-robbed-of-tablets-laptops-tv-and-cash-20190115
Accessed on 2019/02/15

Nicholas, M. 2003. A theory of e-learning. *Educational Technology & Society,* 6(2):1-10.

Njoku, CPU. 2015. Information and communication technologies to raise quality of teaching and learning in higher education institutions. *International Journal of Education and Development using Information and Communication Technology,* 11(1):22-147.

Nkonki, V & Ntlabathi, S. 2016. The forms and functions of teaching and learning innovations on Blackboard: substantial or superficial? *Electronic Journal of e-Learning*, 14(4):257-265.

Norberg, A, Dziuban, CD & Moskal, PD. 2011. A time-based blended learning model, *On the Horizon*, 19(3):207-216.

Norris, P. 2001. *Digital divide: civic engagement, information poverty, and the internet worldwide.* Cambridge: Cambridge University Press.

Northrup, PT.2002. Online learners' preferences for interaction. *The quarterly review of education,* 3(2):219-226.

Nussbaum, M, Cortez, C, Rodriguez, P, Lopez, X & Rosas, R. 2005. *Teacher training with face to face computer supported collaborative learning* (Paper read

at the society for information technology & teacher education international conference, Phoenix, AZ, USA on 1-5 March 2005). [O]. Available:
https://0www.learntechlib.org.oasis.unisa.ac.za/p/19361/
Accessed on 2017/10/01

Nsolly, NB & Charlotte, NMM. 2016. Integration of ICTs into the curriculum of Cameroon primary and secondary schools: a review of current status, barriers and proposed strategies for effective integration. *International Journal of Education and Development using Information and Communication Technology,* 12(1): 89-106.

Nulens, G & Van Audenhove, L. 1999. An information society in Africa? An analysis of the information society policy of the world. *International Communication Gazette,* 61(6):451-471.

Nyumba, TO, Wilson, K, Derrick, CJ & Mukherjee, N. 2018. The use of focus group discussion methodology: insights from two decades of application in conservation. *Methods in Ecology and Evolution,* 9(1):20-32.

O'Brien, R. 1992. Global financial integration: the end of geography. London: Pinter.

Oh, DS & Phillips, F (eds). 2013. *Technopolis: best practices for science and technology cities.* London: Springer.

Okunola, OM, Rowley, J & Jonhson, F. 2017. The multi-dimensional digital divide: perspectives from an e-government portal in Nigeria. *Government information quarterly,* 34(2):329-339.

Omotayo, AO.2016. Adoption of information and communication technologies (ICTs) by Agricultural Science and Extension teachers in Abuja, Nigeria. *Journal of Agricultural Education*, 57(1):137-149.

Organisation for economic cooperation and development (OECD). 2016. *Policy brief on the future of work- skills for a digital world*. Paris: OECD. [O]. Available:

https://www.oecd.org/els/emp/Skills-for-a-Digital-World.pdf
Accessed on 2017/12/07

Organisation for Economic Co-operation and Development. 2016. *South Africa*. Paris: OECD. [O]. Available:
http://www.oecd.org/southafrica/
Accessed on 2017/06/17

Organisation for economic cooperation and development (OECD). 2008. *Reviews of national policies for education: South Africa*. Paris: OECD. [O]. Available:
http://www.oecd.org/southafrica/reviewsofnationalpoliciesforeducation-southafrica.htm
Accessed on 2017/12/14

Organisation for economic co-operation and development. 2001. *Understanding the digital divide.* Paris: OECD. [O]. Available:
https://www.**oecd**.org/sti/1888451.pdf
Accessed on 2017/03/15

Ochara, NM. 2012. Grassroots community participation as a key to e-governance sustainability in Africa. *The African Journal of Information and Communication,* 12(2012): 26-47.

Ogden, R .2008. Anonymity, in *The sage encyclopaedia of qualitative research methods,* edited by LM Given. Calif: Sage: 98. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963909.n11
Accessed on 2017/12/16

Ogden, R. 2008. Confidentiality, *in The sage encyclopaedia of qualitative research methods*, edited by LM Given. Calif: Sage: 113. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963909.n59
Accessed on 2017/12/16

Ogden, R. 2008. Harm, in *The sage encyclopaedia of qualitative research methods*, edited by LM Given. Calif: Sage: 379. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963909.n191
Accessed on 2017/12/16

Ogden, R. 2008. Participant, in *The sage encyclopaedia of qualitative research methods*, edited by LM Given. Calif: Sage: 598-599. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963909.n308
Accessed on 2017/12/16

Ogden, R. 2008. Privacy, in *The sage encyclopedia of qualitative research methods*, edited by LM Given. Calif: Sage:682. [O]. Available:
http://0-dx.doi.org.oasis.unisa.ac.za/10.4135/9781412963909.n338
Accessed on 2017/12/16

Ogunsola, LA & Okusaga, TO. 2006. Digital divide between developed and less-developed countries: the way forward. *Journal of Social Sciences,* 13(2):137-146.

Olatokun, WM. 2008. Internet access and usage by secondary school students in a Nigerian Municipality. *South African Journal of Libraries and Information Science,* 74(2):138-148.

Ololube, NP. 2009. Computer communication and ICT attitude and anxiety among higher education students, in *Encyclopedia of information and communication technology,* edited by A Cartelli & M Palma. Hershey, PA: IGI Global: 100-105.

Ono, H & Zavodny, M. 2008. Immigrants, English ability and the digital divide. *Social Forces*, 86(4):1455-1480.

Ogrezeanu, A & Ogrezeanu, A. 2014. ICT use and attitudes among secondary education teachers in Romania. *E-learning & Software for Education,* 4(1): 458-465.

Osiceanu, ME. 2015. Psychological implications of modern technologies: “technofobia” versus “technophilia”. *Procedia - Social and Behavioral Sciences,* 180(2015): 1137-1144.

Ogunniyi, FGM. 2016. Teachers' perceptions on the use of ICT in a CAL environment to enhance the conception of Science concepts. *Universal Journal of Educational Research,* 4(1):151-156.

Olakulehin, FK. 2007. Information communication technologies in teachers training and professional development in Nigeria. *Turkish Journal of Distance Education,* 8 (1):133-142.

Olele, CN. 2014. Manpower development for information and communication technologies (ICTs) integration in education. *Journal of Business & Educational Leadership,* 5(1):113-126.

Olusegun, BS. 2015. Constructivism learning theory: a paradigm for teaching and learning. *Journal of Research & Method in Education,* 5(6):66-70.

Osborn, D. 2010. African languages in a digital age: challenges and opportunities for indigenous language computing. Ottawa: HSRC Press, IDRC.

Oyewumi, OA. 2006. Agricultural market development through information and communication technology (ICT): a developing country experience. *International Food and Agribusiness Management Review*, 9(2):109-120.

Oyedemi, TD. 2012. Digital inequalities and implications for social inequalities: a study of Internet penetration amongst university students in South Africa. *Telematics and Informatics,* 29(3):302–313.

Oyedemi, T. 2009. Social inequalities and the South African ICT access: policy agendas. *International Journal of Communication,* 3(2009):151-168.

Özdemir, S. 2017. Teacher views on barriers to the integration of information and communication technologies (ICTs) in Turkish Teaching. *International Journal of Environmental & Science Education,* 12(3):505-521.

Paechter, M, Maier, B & Macher, D. 2010. Students' expectation of, and experiences in e-learning: their relation to learning achievements and course satisfaction. *Computers and Education,* 54(1): 222-229.

Palaigeorgiou, G & Grammatikopoulou, A. 2016. Benefits, barriers and prerequisites for Web 2.0 learning activities in the classroom: the view of Greek pioneer teachers. *Interactive Technology and Smart Education,* 13(1):2-18.

Park, EA & Lee, S. 2015. Multidimensionality: redefining the digital divide in the smartphone era. *Info,* 17(2): 80-96.

Patterson, R & Wilson 111, EJ. 2000. New IT and social inequality. *Information society,* 16(1).

Patton, MQ. 2002. *Qualitative research and evaluation methods*. Calif: Sage.

Paton-Ash, M & Wilmot, D. 2015. Issues and challenges facing school libraries in selected primary schools in Gauteng Province, South Africa. *South African Journal of Education,* 35(1):1-10.

Paul, SG, Willamson, JB, Karp, DA & Dalphin, JR. 2007.*The research imagination: an introduction to qualitative and quantitative methods*. Cambridge: Cambridge University Press.

Patton, MQ. 2002. *Qualitative research*. Alexandria: Grace Notes.

Pearce, KE & Ronald, ER. 2014. The language divide-the persistence of English proficiency as a gateway to the internet: the cases of Armenia, Azerbaijan, and Georgia. *International Journal of Communication*, 3(8): 2834-2859.

Pedro, LFMG, de Oliveira Barbosa, CMM & das Neves Santos, CM. 2018. A critical review of mobile learning integration in formal educational contexts.

International Journal of Educational Technology in Higher Education, 15(10):1-15.

Pelet, J. 2014. *E-Learning 2.0 Technologies and Web Applications in Higher Education*. Hershey, PA: IGI Global.

Penjor, CT, Dupka, D & Zander, P. 2016.The state of integration of the virtual learning environment and ICT into the pedagogy of the Royal University of Bhutan: a descriptive study. *International Journal of Education and Development using Information and Communication Technology*, 12(1): 71-88.

Peral-Peral, B, Arenas-Gaitán, J & Villarejo-Ramos, Á. 2015. From digital divide to psycho-digital divide: elders and online social networks. *Comunicar*, 23(45): 57-64.

Perkin, H. 1989. *The rise of professional society: Britain since 1880*. London: Routledge.

Polishuk, P. 2006. *Submarine optic fiber communications systems*. Virginia: WFN strategies. [O]. Available:
https://www.subtelforum.com/issues/Issue%2028.pdf
Accessed 2017/12/11

Pool, J, Reitsma, G & van den Berg, D. 2017. Revised community of inquiry framework: examining learning presence in a blended mode of delivery. *Online Learning*, 21(3): 153-165.

Phellas, CN, Bloch, A & Seale, C. 2011. Structured methods: interviews, questionnaires and observations, in *Researching society and culture*, edited by C Seale.3rd edition. London: Sage: 182-202.

Phillips, P, Wells, J, Ice, P, Curtis, R & Kennedy, R. 2008. A case study of the relationship between socio-epistemological teaching orientations and instructor perceptions of pedagogy in online environments. *Electronic Journal for the Integrating of Technology in Education,* 6(1):3-27.

Pimienta, D. 2011. Digital divide, social divide, paradigmatic divide, in *Human development and global advancements through information communication technologies: new initiatives*, edited by S Chabra & H Rahman. Hershey, PA: IGI Global: 33-48.

Plomp, T & Voogt, J. 2009. Pedagogical practices and ICT use around the world: findings from the IEA international comparative study SITES 2006. *Education and information technologies*, 14(4):285-296.

Poon, J. 2014. A cross-country comparison on the use of blended learning in property education. *Property Management*, 32(2): 154-175.

Ponce, OA & Pagan-Maldonado, N. 2015. Mixed methods research in education: capturing the complexity of the profession. *International Journal of Educational Excellence,* 1(1):111-135.

Pournara, C, Hodgen, J, Adle, J & Pillay, V. 2015. Can improving teachers' knowledge of Mathematics lead to gains in learners' attainment in Mathematics? *South African Journal of Education,* 35(3):1-10.

Ponterotto, JG, Mathew, JT & Raughley, B. 2013. The value of mixed methods design to social justice research in counselling and psychology. *Journal of Social Action in Counselling and Psychology*, 5(2): 42-61.

Porat, MU. 1977. The information economy: definition and measurement. US department of commerce, office of telecommunications. Washington, DC. *OT Special Publications*, 1(3):12-77.

Pule, D. 2010. *E-Skills Key to our Future* (Opening address by the South African Deputy Minister of Communications at the E-Skills Summit, Cape Sun Hotel, Cape Town, South Africa on 26-28 July).

Pritchard, A. 2007. *The internet, pedagogy and learning, in effective teaching with internet technologies: pedagogy and practice*. London: Sage.

Quan-Baffour, KP & Arko-Achemfuor, A. 2009. Bridging the content knowledge gap of teachers: an agenda to improve Business Studies teaching in South African countryside schools. *Problems of education in the 21st century,* 12(12):108-116.

Rabah, J. 2015. Benefits and challenges of information and communication technologies (ICT) integration in Québec English schools. *The Turkish Online Journal of Educational Technology,* 14(2):24-31.

Radu, RG. 2012. From drift to draft: international institutional responses to the global digital divide, in *Globalization, technology diffusion and gender disparity: social impacts of ICTs,* edited by R Pande & T Van der Weide. Hershey. PA: IGI Global: 83-94.

Raffinetti, C. 2015. Licensing of communications networks and services: case study of market liberalisation in South Africa and the United Kingdom. *The African Journal of Information and Communication,* 2015(14): 50-61.

Ragnedda, M & Muschert, GW .2013. Max Weber and digital divide studies. *International Journal of Communication,* 9(2015): 2757–2762.

Raman, K & Yamat, H. 2014. Barriers teachers face in integrating ICT during English lessons: a case study. The Malaysian *Online Journal of Educational Technology,* 2(3):11-19*.*

Ramnarain, U & Fortus, D. 2013. South African physical sciences teachers' perceptions of new content in a revised curriculum. *South African Journal of Education*, 33(1):1-15.

Rasool, F. 2012. Teacher Laptop Initiative strengthened. *ITWeb,* 12 May. [O]. Available:
http://www.itweb.co.za/index.php?option=com_content&view=article&id=54962:teacher-laptop-initiative-strengthened&catid=147
Accessed on 2017/06/12

Ravi, S, Sharma, EM & SEWJ. Ng. 2009. "Beyond the digital divide: policy analysis for knowledge societies". *Journal of Knowledge Management*, 13(5):373-38.

Reddy, V, Visser, V, Winnaar, L, Arends, F, Juan, A, Prinsloo, CH & Isdale, K. 2016. *TIMSS 2015: Highlights of Mathematics and Science Achievement of Grade 9 South African Learners*. Pretoria: Human Sciences Research Council. [O]. Available:
http://www.hsrc.ac.za/en/research-data/view/8456
Accessed 2017/12/23

Research ICT Africa Policy. 2012. *Brief No.1. Africa Prepaid Mobile Price Index: South Africa*. [O]. Available:
http://www.researchictafrica.net/docs/SA_Mobile_Prepaid_policy_brief.pdf
Accessed on 2017/05/12

Research ICT Africa. Policy Brief no. 1. Quarter 1. 2015. *Consumers benefit from lower mobile termination rates.* [O]. Available:
https://www.researchictafrica.net/docs/RIA%20Policy%20Brief%20Q12015_Final.pdf
Accessed on 2017/06/17

Research ICT Africa. 2016. *Alternatives for Affordable Communications in rural South Africa: Social Purpose GSM Licenses.* [O]. Available:
https://www.researchictafrica.net/publications/Other_publications/2016_Submission%20Cost%20to%20Communicate-Rural%20Connectivity%20South%20Africa.pdf
Accessed on 2017/05/17

Research ICT Africa. 2017. *Internet use barriers and user strategies: perspectives from Kenya, Nigeria, South Africa and Rwanda.* [O]. Available:
https://www.researchictafrica.net/docs/RIA%202016%20Comparative%20FGD%20study_Final_Web%20version.pdf
Accessed on 2019/07/19

Reshef, R. 2018. A breakthrough power solution for rural telecom towers. *Powering engineering international*. [O]. Available: *anais@incus-media.com*
Accessed on 2019/05/28

Rittel, H & Webber, M. 1973. Dilemmas in general theory of planning. *Policy Sciences, (*4)155-169.

Ritzhaupt, A, Liu, F, Dawson, K & Barron, AE. 2013. Differences in student information and communication technology literacy based on socio-economic status, ethnicity, and gender: evidence of a digital divide in Florida schools. *Journal of Research on Technology in Education*, 45(4):291-307.

Roberts, N. 2017. *School Maths: What is our story?* [O]. Available:
https://www.dailymaverick.co.za/article/2017-01-08-school-maths-what-is-our-story/#.Wfw9rmiCyyI
Accessed on 2017/11/03

Robins, K & Webster, F. 1987. Information as capital: a critique of Daniel Bell, in *The ideology of the information age*, edited by JD Slack & F Fejes. New Jersey: Ablex: 95-117.

Rosamond, B. 2007. The political sciences of European integration: disciplinary history and EU studies, in *The sage handbook of European Union politics,* edited by KE Jørgensen, MA Pollack & B Rosamond. London: Sage: 7-30.

Roszak, T. 1986. *The cult of information: the folklore of computers and the true art of thinking.* Cambridge: Lutterworth.

Rouse, M. 2005. ICT (information and communications technology). [O]. Available:
http://searchcio.techtarget.com/definition/ICT-information-and-communications-technology-or-technologies
Accessed on 2017/08/27

Saadatmand, M. 2017. *Toward open networked learning environments: an ecological approach to learning design in MOOCs* (Paper read at the association for the advancement of computing in education, Washington, DC, United States on 20-23 June 2017). [O]. Available:
http://0-www.learntechlib.org.oasis.unisa.ac.za/p/178412/
Accessed on 2018/12/12

Sabzian, F & Gilakjani, AP. 2013. Teachers' attitudes about computer technology training, professional development, integration, experience, anxiety, and literacy in English language teaching and learning. *International Journal of Applied Science and Technology,* 3(1): 67-75.

Sacholeva, N, Kai, TA, Kimppa, K & Suomi, R. 2015. Digital disability divide in information society. *Journal of Information Communication and Ethics in Society,* 13(3/4): 283-298.

Sackman, H. 1967. *Computers, system science, and evolving society: the challenge of man-machine digital systems*. New York: Wiley.

Sanchez-Santamaria, J, Ramos, FJ & Sánchez-Antolín, P. 2012. *The student's perspective: teaching usages of Moodle at university* (Paper read at the ICER conference, Madrid, Spain on 19th-21st November 2012).

Sangrà, A, Vlachopoulos, D & Cabrera, N. 2012. Building an inclusive definition of e-learning: an approach to the conceptual framework. *The International Review of Research on Open and Distance Education,* 13(2):146-159.

Sanfilippo, RM. 2016. *An unequal information society: how information access initiatives contribute to the construction of inequality.* Indiana: Indiana University.

Sarrocco, C. 2002. Improving IP connectivity in least developed countries: breaking the vicious circle. *Informatics,* 4(3):14-28.

Sayed, Y & Motala, S. 2012. Equity and 'No Fee' schools in South Africa: challenges and prospects. *Social Policy & Administration*, 46(6):672-687.

Sebina, M & Mazebe, P. 2014. *Digital access and e-government: perspectives from developing and emerging countries.* Hershey PA: IGI Global.

Selwyn, N & Facer, K. 2010. Beyond digital divide: toward an agenda for change, in, *Overcoming digital divides: constructing an equitable and competitive information society*, edited by E Ferro, YK Dwivedi, JR Gil-Garcia & MD Williams. Hershey: Information science reference: 1-20.

Semerci, A & Aydin, MK. 2018. Examining high school teachers' attitudes towards ICT use in education. *International Journal of Progressive Education*, 14(2): 93-105.

Sesabo, JK, Mfaume, R & Msabila, DT. 2015. Opportunities and challenges in implementing distance learning and e-learning: a case study, in *Handbook of research on educational technology integration and active learning*, edited by J Keengwe. Hershey, PA: IGI Global: 329-345.

Sivo, SA, Saunders, C, Chang, O & Jiang, JJ. 2006. How low should you go? Low response rates and validity of inference in IS questionnaire research. *Journal of the Association of Information System*, 7(6):351-414.

SchoolNet SA. 2017. *Intel® Transforming Learning Series*. [O]. Available:
http://www.schoolnet.org.za/teacher-development/intel-teach/
Accessed on 2017/06/11

SchoolNet SA. 2017. *Intel® Teach in South Africa.* [O]. Available:
http://www.schoolnet.org.za/teacher-development/intel-teach/intel-teach-overview/intel-teach-in-south-africa/
Accessed on 2017/06/16

Schwandt, TA, Lincoln, YS & Guba, EG. 2007. Judging interpretations: but is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Evaluation*, 2007(114):11- 25.

Seale, C. 1999. *The quality of qualitative research.* London: Sage.

Seetaram, N, Gill, A, & Dwyer, L. 2012. *Handbook of research methods in tourism: quantitative and qualitative approaches*. Cheltenham: Edward Elgar.

Skaletsky, S, Soremekun, O & Galliers, RD. 2014. The changing-and unchanging-face of the digital divide: an application of Kohonen self-organizing maps. *Information Technology for Development,* 20(3): 218-250.

Sikhakhane, B, Lubbe, S & Klopper, R. 2005. The digital divide and access to information communication technologies: an investigation into some problems in rural local communities in KwaZulu-Natal, South Africa. *Alteration*, 12(1): 43-66.

Singh, S & Travica, B. 2018. E-Government systems in South Africa: an info culture perspective. *The Electronic Journal of Information Systems in Developing Countries*, 84(4): 1-16.

Singh, YK. 2007. *Philosophical foundation of education*. New Delhi: APH.

Singh, AM. 2004. Bridging the digital divide: the role of universities in getting South Africa closer to the global information society. *South African Journal of Information Management,* 6(2): 2-9.

Sithole, MM, Moses, C, David, DY, Parker, S, Rumbelo, J, Molotja, N & Labadariosb, D. 2013. Extent of access to information and communications technology by the rural population of South Africa. *African Journal of Science, Technology, Innovation and Development, 5*(1): 71-84.

Shan Fo, J. 2013. ICT in education: a critical literature review and its implications. *International Journal of Education and Development using Information and Communication Technology*, 9(1):112-125.

Shelley, MC, Thrane, LE & Shulman, SW. 2006. Generational differences in information technology use and political involvement. *International Journal of Electronic Government Research,* 2(1): 36-53.

Shing, CL, Mohd. Saat, R & Loke, SH. 2015. The knowledge of teaching-pedagogical content knowledge (PCK). *The Malaysian Online Journal of Educational Science,* 3(3): 40-55.

Shizha, E & Diallo, L. 2016. *Africa in the age of globalisation: perceptions, misperceptions and realities.* London: Routledge.

Spaull, N. 2013. Information South African policy. *Report on South Africa's education crisis*: *the quality of education in South Africa 1994-2011*. Chairperson: L Dippenaar.

Shulman, LS. 1986. Those who understand: knowledge growth in teaching. *Educational Researcher,* 15(2): 4-14.

Smit, PJ. 2013. *Rationales for modern ICT Implementation into schools: a case of tablet PCs.* Educational Science and Technology. Twente: University of Twente.

Smyth, S, Houghton, C, Cooney, A & Casey, D.2012. Students' experiences of blended learning across a range of postgraduate programmes. *Nurse Education Today,* 32(4): 464-468.

Souchon, L, Aebischer, B, Roturier, J & Flipo, F. 2007. Infrastructure of information society and its energy demand. European Council for an Energy Efficient Economy (ECEEE) Summer Studies Proceedings. [O].Available: https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2007/Panel_6/6.233/ Accessed on 2018/05/13

South Africa. Department of Communications. 2010. *Broadband policy for South Africa*. *Government Notice No. 597: Government Gazette No. 33363*. [O]. Available:
http://www.ellipsis.co.za/wp-content/uploads/2013/03/National-Broadband-Plan-2010.pdf
Accessed on 2017/05/12

South Africa. Department of Communications .2011. *E-Barometer: Measuring the impact of ICTs on development in South Africa*. Pretoria: [sn].

South Africa. Department of Communications. 2014. *The national integrated ICT Policy Green Paper Executive summary.* [O]. Available:
www.doc.gov.za
Accessed on 2017/03/10

South Africa. Department of Education Government Gazette. 2004. *Draft White Paper on e-education: transforming learning and teaching through information and communication technologies* (ICTs), Vol. 407 No. 267734*.* [O]. Available:
http://www.gov.za/documents/white-papers
Accessed on 2017/08/27

South Africa. Department of Education. 2017. *School fees and exemption*. [O]. Available:
https://www.education.gov.za/Parents/NoFeeSchools/tabid/408/Default.aspx
Accessed on 2017/10/05

South Africa. Department of the Presidency. 2014. *National planning commission*: *diagnostic overview.* Chairperson: TA Manuel. [O]. Available:
https://www.gov.za/sites/default/files/gcis_document/201409/npcdiagnosticoverview1.pdf
Accessed on 2019/05/30

South Africa. Department of Planning, Monitoring and Evaluation. [Sa].*National planning commission.* [O]. Available:
http://www.nationalplanningcommission.org.za/Pages/About-Us.aspx
Accessed on 2017/05/19

South Africa. Department of Public Service and Administration.1997. *Batho Pele-"people first" White paper on transforming public service delivery.* [O]. Available:
www.dpsa.gov.za
Accessed on 2017/06/03

South Africa. Department of Telecommunications and Postal Services. 2016. *National Integrated ICT Policy White Paper.* [O]. Available:
https://www.dtps.gov.za/images/phocagallery/Popular_Topic_Pictures/National_Integrated_ICT_Policy_White.pdf
Accessed on 2019/05/25

South African Government News Agency. 2015. *Progress made in ICT roll out in Gauteng schools.* [O]. Available:
http://www.sanews.gov.za/south-africa/progress-made-ict-roll-out-gauteng-schools
Accessed on 2017/06/11

South Africa: Parliamentary monitoring group. Telecommunications and Postal Services. 2014. *Costs of telecommunications: ICASA Vodacom, MTN, Cell C, Telkom & Neotel briefings.* Chairperson: M Kubayi. [O]. Available:
https://pmg.org.za/committee-meeting/17832/
Accessed on 2017/04/11

South African government. 2010. *Teacher laptop initiative rollout launch.* [O]. Available:
http://www.gov.za/teacher-laptop-initiative-rollout-launch
Accessed on 2017/06/16

South African Government. 2015. *Gauteng Education on roll-out of ICT in schools*. [O]. Available:
http://www.gov.za/speeches/gauteng-education-roll-out-ict-schools-20-jul-2015-0000
Accessed on 2017/06/11

South Africa. Draft White Paper on e-Education. 2003. *Transforming learning and teaching through ICT*. [O]. Available:
http://www.gov.za/documents/white-papers
Accessed on 2016/08/27

South Africa. General Household Survey. 2013. *Statistical release P0318.* Pretoria: Statistics South Africa. [O]. Available:
www.statssa.gov.za/publications/P0318/P03182013
Accessed on 2017/06/30

South Africa. Statistics South Africa. 2011. *Emfuleni*. [O]. Available:
http://www.statssa.gov.za/?page_id=993&id=emfuleni-municipality
Accessed on 2017/08/27

South Africa. Statistics South Africa: Country report. 2013*. Report on Millennium Development Goals.* Pretoria: Statistics South Africa. Chairman: P Lehohla. [O]. Available:
www.statssa.gov.za/wp-content/uploads/2013/.../MDG_October-2013.pdf
Accessed on 2017/07/10

South Africa. Statistics South Africa: General Household Survey. 2014*. Statistical release P0318*. Pretoria: Statistics South Africa*.* [O]. Available:
www.statssa.gov.za/publications/P0318/P03182014.pdf
Accessed on 2016/07/10

South Africa. Statistics South Africa. 2016. *Quarterly Labour Force Survey P0211: Quarter 1.* [O]. Available:
www.statssa.gov.za/publications/P0211/P02111stQuarter2016.pdf
Accessed on 2016/07/12

South Africa. Statistics South Africa. 2018. *Statistical Release P0318*: *General household survey.* [O]. Available:
http://www.statssa.gov.za/publications/P0318/P03182018.pdf
Accessed on 2019/05/30

South African education system one of the worst in the world. 2017. *News 24, 1* June. [O]. Available:

https://www.news24.com/SouthAfrica/News/sa-education-system-one-of-the-worst-in-the-world-the-economist-20170106
Accessed on 2017/01/04

South Africa. Task Group, the Presidential National Commission on Information Society and Development. [Sa]. *Report of the task group on the National Information Society and Development (ISAD).* Chairperson: L Shope-Mafole. [O]. Available:
https://www.dtps.gov.za/index.php?option=com...view...399:isad...isad...
Accessed on 2017/05/22
South Africa. The Local Government Handbook: A complete guide to municipalities in South Africa 2012-2015. *Sedibeng District Municipality (DC42).* [O]. Available:
http://www.localgovernment.co.za/districts/view/14/sedibend-District-Municipality
Accessed 2017/08/17

South Africa. Thusong service centre. 2000. *The establishment of government multi-purpose community centres.*
[O]. Available:
http://www.thusong.gov.za/documents/research/plan.htm
Accessed on 2019/05/30

South Africa. Thusong service centre. [Sa]. *The government development communication initiative: a response to democratic communication and citizen participation in South Africa.*
[O]. Available:
http://www.thusong.gov.za/documents/policy_legal/gdc.htm
Accessed on 2017/05/11

South Africa. Western Cape Government. 2007. *Free computer and internet access - thanks to city's smart cape access project*. [O]. Available:
https://www.westerncape.gov.za/news/free-computer-and-internet-access-thanks-citys-smart-cape-access-project Accessed on 2017/05/28

Southworth, G. 2005. Learning-centred leadership, in *The essentials of school leadership,* edited by B Davies. London: Sage: 91-111.

Spires, HA, Wiebe, E, Young, CA, Hollebrands, K & Lee, JK. 2012. Toward a new learning ecology: professional development for teachers in 1:1 learning environments. *Contemporary Issues in Technology and Teacher Education,* 12(2): 232-254.

Spaull, N. 2015. Schooling in South Africa: How low-quality education becomes a poverty trap. South African child gauge. [O. Available: http://www.ci.uct.ac.za/sites/default/files/image_tool/images/367/Child_Gauge/South_African_Child_Gauge_2015/Child_Gauge_2015-Schooling.pdf
Accessed on 2019/05/30

Stake, R. 1978. The case study method in social inquiry. *Educational Researcher,* 7 (2): 5-8.

Stake, R. 2000. Case studies, in *Handbook of Qualitative Research*, edited by N Denzin & Y Lincoln. Calif: Sage: 435-453.

Stake, R. 2005. Qualitative case studies, in *The sage handbook of qualitative research,* edited by N Denzin & Y Lincoln. Thousand Oaks, Calif: Sage: 433-466.

Stehr, N. 1994. *Knowledge Societies*. London: Sage.

Stoilescu, D & McDougall, D. 2011. Gender digital divide and challenges in undergraduate computer science programs. *Canadian Journal of Education,* 34(1): 308-333.

Stork, C, Calandro, E & Gillwald, Al. 2013. Internet going mobile: internet access and use in 11 African countries. *Info*, 15(5): 34-51.

Stern, MJ, Adams, AE, Elsasser, S. 2009. Digital inequality and place: the effects of technological diffusion on internet proficiency and usage across rural, suburban, and urban counties. *Sociological Inquiry,* 79(4): 391-417.

Steyn, J & Van Greunen, D. 2014. *ICTs for inclusive communities in developing societies (*Paper read at the 8th international development informatics association conference, Port Elizabeth, South Africa on 3-4 November 2014). [O]. Available: www.developmentinformatics.org/conferences/.../20-Nkula-Kirsten.pdf
Accessed on 2017/03/16

Steyaert, J. 2002. Inequality and the digital divide: myths and realities, in *Advocacy, activism and the internet*, edited by S Hick & J McNutt. Chicago: Lyceum Press: 199-211.

Swallow, MJC & Olofson, MW. 2017. Contextual understanding in the TPACK Framework. *Journal of research in educational technology*, 49(3-4): 288-244.

Talsik, E. 2015. Assessing the intention to use e-learning technologies among pre-service music teachers in Turkey. *Journal of Education and Sociology,* 6(1): 539-545.

Tan Wee, L & Subramanian, R. 2009. *Handbook of research on new media literacy at the K-12 level: issues and challenges.* Hershey: IGI Global.

Tashakkori, A & Teddlie, C. 2010. *Sage handbook of mixed methods in social & behavioural research*. Calif: Sage.

Tashakkori, A & Creswell, JW. 2007. Exploring the nature of research questions in mixed methods research. *Journal of Mixed Methods Research*, 1(3): 207-211.

Teddlie, C & Tashakkori, A. 2009. *Foundations of mixed methods research: integrating quantitative and qualitative approaches in the social and behavioural sciences.* London: Sage.

Tella, A, Tella, A, Majekodunmi, A Toyobo, OM, Adika, LO & Adeyinka, AA. 2007. An assessment of secondary school teachers' uses of ICT's: implications for further development of ICT's use in Nigerian secondary schools. *The Turkish Online Journal of Educational Technology,* 6(3):1-13.

Terranova, T. 2000. Post-human unbounded: artificial evolution and high-tech subcultures, in *The Cybercultures Reader,* edited by D Bell & BM Kennedy. London: Routledge: 268 - 279.

Thapa, D & Sein, MK. 2018. An ecological model of bridging the digital divide in education: a case study of OLPC deployment in Nepal. *Information Systems in Developing Countries,* 84(2): 1-9.

Thaver, LL. 2015. The ambivalence of modern technology and the 'digital divide' gathering and scattering of sociality and sociability in the global network society. *South African Journal of Higher Education, 29*(4): 1-13.

The Centre for Development and Enterprise. 2013. *Mathematics Outcomes in South African schools. What are the facts? What should be done?* [O]. Available: https://www.cde.org.za/mathematics-outcomes-in-south-african-schoolswhat-are-the-facts-what-should-be-done
Accessed on 2017/01/04

The Commonwealth Telecommunications Organisation. 2012. *The socio-economic impact of broadband in Sub-Saharan Africa: the satellite advantage*. [O].Available:
http://www.cto.int/media/research/projects/SocioEconomic_Impact_of_Broadband_The_Satellite_Advantage.pdf
Accessed 2017/09/04

The Guardian view on the importance of literacy. 2014. *The Guardian*, 12 September. [O]. Available:
https://www.theguardian.com/commentisfree/2014/sep/12/editorial-guardian-view-on-literacy
Accessed on 2017/03/28

The South African Institute of International Affairs (SAIIA). 2017. *No woman left behind: The gender digital divide.* [O]. Available:
https://saiia.org.za/research/no-woman-left-behind-the-gender-digital-divide/
Accessed on 2019/05/30

The World Bank. 2008. *Sustainable Infrastructure Action Plan - FY 2009-2011*. The World Bank Group. [O]. Available:
https://siteresources.worldbank.org/INTSDNETWORK/Resources/SIAPbooklet.pdf
Accessed on 2017/12/12

The World Bank. 2011. *Africa's ICT infrastructure: building on the mobile revolution.* [O]. Available:
http://documents.worldbank.org/curated/en/375261468204545149/Africas-ICT-infrastructure-building-on-the-mobile-revolution
Accessed on 2017/01/ 08

The World Bank. 2012. *Mobile phone access reaches three quarters of planet's population.* [O]. Available:
http://www.worldbank.org/en/news/press-release/2012/07/17/mobile-phone-access-reaches-three-quarters-planets-population
Accessed on 2017/05/13

The World Bank. 2017*. Overview: state of electricity access report (SEAR).* [O]. Available:
http://documents.worldbank.org/curated/en/285651494340762694/pdf/114841-ESM-PUBLIC-P148200-32p-FINALSEAROverviewWEB.pdf
Accessed on 2018/07/06

Thomas, PE .2015. The making of the information society: taxonomy of concepts, determinants, and implications, in *Handbook of research on cultural and economic impacts of the information society* , edited by P Thomas, M Srihari & S Kaur. Hershey, PA: IGI Global: 1-24. [O]. Available:
https://0-www-igi--global-com.oasis.unisa.ac.za/gateway/chapter/135840?ct=-8586511255919602442
Accessed on 2018/08/12

Thomas, RM. 2003. *Data-collection processes and instruments*. Calif: sage.

Thomas, HE. 2006. *The Sustainable Implementation of Computers in School Districts: A Case Study in the Free State Province of South Africa.* University of Pretoria: Pretoria. (Masters Dissertaion).

Thunman, E & Persson, M. 2013. Teachers' access to and use of ICT: An indicator of growing inequity in Swedish Schools. *Contemporary educational technology*, 4(3): 155-171.

Thutong South African education portal. [SI]. Brand South Africa. 2012. [O]. Available:
https://www.brandsouthafrica.com/governance/services/education-services/thutong
Accessed on 2017/06/11

Ticehurst, GW & Veal, AJ. 2000. *Business research methods: a managerial approach.* Melbourne: Longman.

Tobin, GA & Begley, CM. 2004. Methodological rigour within a qualitative framework. *Journal of Advanced Nursing*, 48(4): 388-396.

Tomei, LA. 2012. *Learning tools and teaching approaches through ICT advancements*. Hershey PA: Information Science Reference.

Tongco, MDC. 2007. Purposive sampling as a tool for informant selection. *Ethnobotany Research & Applications,* 5(2007): 147-158.

Towers, S & Oliver, R. 2000. Benchmarking ICT literacy in tertiary learning settings, in *Learning to choose: Choosing to learn,* edited by R Sims, M O'Reilly & S Sawkins, page 381-390. Proceedings of the 17th Annual ASCILITE Conference Lismore, NSW: Southern Cross University Press.

Tubbs, B. 2013. Teacher Laptop Initiative mired. *ITWeb,* 24 January. [O]. Available:
http://www.itweb.co.za/index.php?option=com_content&view=article&id=61280:Teacher-Laptop-Initiative-mired&catid=69 Accessed on 2017/06/16

Tubin, D. 2006. When ICT meets schools: differentiation, complexity and adaptability. *Journal of Educational Administration,* 45(1): 8-32.

Ukwandu, E & Nnamocha, P. 2013. The effects of information technology on global economy. *The Social Sciences*, 8(6): 606-609.

Umugiraneza, O, Bansilal, S & North, D. 2018. Exploring teachers' use of technology in teaching and learning mathematics in KwaZulu-Natal schools. *Pythagoras,* 39(1): 342.

United Nations Educational, Scientific and Cultural Organisation. 2006. *Education for All Global Monitoring Report*.
[O]. Available:
http://www.unesco.org/education/GMR2006/full/chapt5_eng.pdf
Accessed on 2017/04/21

United Nations. 2016. Leaving no one behind: the imperative of inclusive development. *Report on the World Social Situation*. New York. Chairperson: W Yang. [O]. Available: https://www.un.org/esa/socdev/rwss/2016/full-report.pdf
Accessed on 2019/05/30

United Nations conference on Trade and Development: Transformational energy access. 2017. *Report on the least developed countries.* Geneva. Chairperson: Rolf Traeger. [O]. Available:
https://unctad.org/en/PublicationsLibrary/ldcr2017_en.pdf
Accessed on 2019/05/28

United Nations Educational, Scientific and Cultural Organisation (UNESCO) Institute for statistics. 2017. *Literacy Rates Continue to Rise from One Generation to the Next.* [O]. Available:
http://uis.unesco.org/sites/default/files/documents/fs45-literacy-rates-continue-rise-generation-to-next-en-2017_0.pdf
Accessed on 2018/07/06

Vágvölgyi, R, Coldea, A, Dresler, T, Schrader, J & Nuerk, HC. 2016. A Review about functional illiteracy: definition, cognitive, linguistic, and numerical aspects. *Frontiers in Psychology,* 10(7): 1617.

Valk, JH, Rashid, AT & Elder, L. 2010. Using mobile phones to improve educational outcomes: an analysis of evidence from Asia. *The International Review of Research in Open and Distance Learning,* 11(1):117-140.

Van Biljon, J. 2016. Development informatics research and the challenges in representing the voice of developing country researchers: a South African view. *The African Journal of Information and Communication,* 18:75-94.

Van Audenhove, L. 2003. Theories on the information society and development: recent theoretical contributions and their relevance for the developing world. *Communicatio,* 29(1):48-67.

van Deursen, AJAM & van Dijk, JAGM. 2019. The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media & Society*, 21(2): 354-375.

van Deursen, AJAM, ben Allouch, S & Ruijter, LP. 2016. Tablet use in primary education: adoption hurdles and attitude determinants. *Education and Information Technologies,* 21(5): 971-990.

van Deursen, AJAM & van Dijk, JAGM. 2015. Toward a multifaceted model of internet access for understanding digital divides: an empirical investigation. *The Information Society*, 31(5): 379-391.

van Deursen, AJAM & Helsper, EJ. 2015. The third level digital divide: who benefits most from being online? *Communication and Information Technologies*, 4(10): 29-52.

van Deursen, AJAM & van Dijk, JAGM. 2014. The digital divide shifts to differences in usage. *New Media & amp Society,* 16(3):507-526.

van Deursen, AJAM & van Dijk, JAGM. 2010. Measuring internet skills. *International Journal of Human Computer Interaction*, 26:891-916.

Van Dijk, D. 1999. *The network society: social aspects of new media*. Calif: Sage.

van Dijk, J & Hacker, K. 2003. The digital divide as a complex, dynamic phenomenon. *The Information Society,* 19(4): 315-326.

van Dijk, JAGM. 2005. *The deepening divide: Inequality in the information society*. Calif: Sage.

Van Dijk, J. 2008. *The handbook of internet politics.* London: Routledge.

Van Dijk, JAGM. 2012. The evolution of the digital divide: the digital divide turns to inequality of skills and usage, in *Digital enlightenment yearbook,* edited by, J Bus, M Crompton, M Hildebrandt & G Metakides. Amsterdam: IOS :57-78.

Van Dijk, JAGM. 2017. Digital divide: impact of access, in *The international encyclopedia of media effects,* edited by P Rössler, CA Hoffner & L van Zoonen. New Jersey:John Wiley & sons:1-11. [O]. Available: https://www.utwente.nl/en/bms/vandijk/publications/digital_divide_impact_access.pdf Accessed on 2019/05/25

Van der Westhuizen, D & de Bruin, G. 2005. *Empowering teachers for educational ICT competence: a South African case study* (Paper read at the AACE society for information technology & teacher education international conference, Phoenix, AZ, USA on 24 March 2005). [O]. Available: http://0-www.learntechlib.org.oasis.unisa.ac.za/p/19444/
Accessed on 2017/10/18

Van Zyl, G. 2013. Why Kenya’s fixed line market is shrinking. *ITWeb Africa,* 22 January. [O]. Available: http://www.itwebafrica.com/kenya/230536-kenyas-fixed-line-network-market-shrinks Accessed on 2017/04/12

Vinila, T. 2016. ICT empowered teaching, learning and evaluation. *International Journal of Advanced Scientific Technologies in Engineering and Management Sciences,* 2(1): 22-23.

Visser, M, Juan, A & Feza, N. 2015. Home and school resources as predictors of mathematics performance in South Africa. *South African Journal of Education*, 35(1): 1-10.

Vivier, E, Seabe, D, Wentzel, M & Sanchez, D. 2015. From information to engagement: exploring communication platforms for the government-citizen interface in South Africa. *The African Journal of Information and Communication,* 15(2015): 81-92.

Wahyuni, D. 2012.The research design maze: understanding paradigms, cases, methods and methodologies. *Journal of Applied Management Accounting Research*, 10(1): 69-80.

Wagner, DA & Kozma, R. 2005. *New technologies for literacy and adult education: a global perspective.* Paris: United Nations Educational, Scientific and Cultural Organization. [O]. Available: http://www.unesco.org/new/en/communication-and information/resources/publications-and-communication materials/publications/full-list/new-technologies-for-literacy-and-adult-education-a-global-perspective/
Accessed on 2017/10/22

Wagner, DA, Day, B, James, T & Kozma, R, Miller, J & Unwin, T. 2005. Monitoring and evaluation of ICT in education projects: a handbook for developing countries. [O].Available:http://www.infodev.org/infodevfiles/resource/InfodevDocuments_9.pdf Accessed on 2019/03/24

Warf, B. 2013. Contemporary digital divides in the United States. *Tijdschrift Voor Economische en Sociale Geografie*, 104(1):1-17.

Warschauer, M. 2004. *Technology and social inclusion: rethinking the digital divide*. Cambridge: MIT Press.

Watson, J 2008. Blending Learning: The convergence of online and face-to-face education. [O]. Available:
https://files.eric.ed.gov/fulltext/ED509636.pdf
Accessed on 2019/05/31

Wawire, OF & Messah, O.2010. Challenges faced in establishing university libraries in Kenya. *International Journal of Library and Information Science*, 2(8):148-154.

Webster, F. 2005. *Theories of the information society*. London: Routledge.

Webster, F. 2006. *Theories of the information society*. 3rd edition. London: Routledge.

Webster, F. 2008. *Information Society.* London: Routledge.

Wentrup, R, Ström, PH & Nakamura, R. 2016. Digital oases and digital deserts in Sub-Saharan Africa. *Journal of Science & Technology Policy Management,* 7(1):77-100.

Wessels, B. 2010. E-inclusion: European perspectives beyond the digital divide, in *Encyclopedia of e-business development and management in the global economy,* edited by I Lee. Hershey: Business Science Reference/Global: 1068-1075.

Western, M. 2014. Using quantitative data in the social sciences, in *Handbook of research methods and applications in spatially integrated Social Science,* edited by RJ Stimson*.* Cheltenham: Edward Elgar: 150-162.

Weybright, EH, Caldwell, LL, Xie, HJ, Wegner, L & Smith, EA. 2017. Predicting secondary school dropout among South African adolescents: a survival analysis approach. *South African Journal of Education*, 37(2): 1-11.

Willard, NE. 2007. *Cyberbullying and cyber threats: responding to the challenge of online social aggression, threats, and distress*. Illinois: Research Press.

Williams, MDJ. 2010. *Broadband for Africa: developing backbone communications networks.* Washington, DC: The World Bank. [O]. Available:
https://cto.int/wp-content/themes/solid/_layout/dc/k-r/Broadband_for_Africa.pdf
Accessed on 2019/05/28

Williams, M, Mayer, R & Minges, M. 2011. *Africa's ICT infrastructure*. Washington, DC: The World Bank. [O]. Available:
https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-8454-1
Accessed on 2017/10/12

Williams, PJ & Gumbo, M. 2012. *Discovering technology teachers' pedagogical content knowledge: a comparative study between South Africa and New Zealand* (Paper read at the PATT 26th conference, technology education in the 21st Century Stockholm, Sweden on 26-30 June 2012). [O]. Available:
http://www.ep.liu.se/ecp/article.asp?article=056&issue=073&volume
Accessed on 2017/06/19

Wilkin, CL, Rubino, C, Zell, D & Shelton, LM. 2013. Where technologies collide: a technology integration model, in *Increasing student engagement and retention using classroom technologies: classroom response systems and mediated discourse technologies (cutting-edge technologies in higher education, volume 6 part E),* edited by C Wankel, P Blessinger. Bingley: Emerald Group: 81-106.

Wilson, EJ. 2006. *The information revolution and developing countries*. Cambridge: MIT Press.

Wuensch, K, Aziz, S, Ozan, E, Kishore, M & Tabrizi, MHN. 2008. Pedagogical Characteristics of Online and Face-to-Face Classes. *International Journal on E-Learning, 7*(3):523-532.

Wicks, AC & Freeman, RE. 1998. Organization studies and the new pragmatism: positivism, anti-positivism, and the search for ethics. *Organization Science,* 9(2): 123-140.

World Wide Web Foundation. 2016. *Report cards: Women's rights online*. [O]. Available:
http://webfoundation.org/docs/2016/09/WRO-Gender-Report-Card_Overview.pdf
Accessed on 2019/05/30

Xiao, J. 2017. Learner-content interaction in distance education: the weakest link in interaction research. *Distance education,* 38(1):123-135.

Young, S. 2006. Student view of effective of teaching online in higher education. *The American Journal of Distance Education,* 20(2): 65-77.

Young, K. 2016. Teachers' attitudes to using ipads or tablet computers: implications for developing new skills, pedagogies and school-provided support. *Technological Trends: Linking Research and Practice to Improve Learning*, 60(2):183-189.

Yuen, AHK, Law, N & Wong, KC. 2003. ICT implementation and school leadership: case studies of ICT integration in teaching and learning. *Journal of Educational Administration,* 41(2): 58-170.

Yusof, YM & Zakaria, E. 2015. The integration of teacher's pedagogical content knowledge components in teaching linear equation. *International Education Studies,* 8(11): 26-33.

Yusuf, MO & Balogun, MR. 2011. Student-teachers' competence and attitude towards information and communication technology: a case study in a Nigerian University. *Contemporary Educational Technology,* 2(1): 18-36.

Zachery, LW. 2009. Information society discourse, i*n Encyclopaedia of information science and technology,* edited by M Khosrow-Pour. 2nd edition. Hershey, PA: IGI Global: 89-101.

Zaka, P. 2013. A case study of blended teaching and learning in a New Zealand secondary school, using an ecological framework. *Journal of Open, Flexible, and Distance Learning,* 17(1): 24-40.

Ziphorah, RM. 2014. Information and communication technology integration: where to start, infrastructure or capacity building? *Social and Behavioural Sciences,* 116(2014): 3649-3658.

Zyad, H. 2016. Integrating computers in the classroom: barriers and teachers' attitudes. *International Journal of Instruction,* 9(1): 65-78.

ADDENDA

Addendum A: Interview guide for school principals

SEMI- STRUCTURED INTERVIEW GUIDE

INTRODUCTION

My name is Grasia Chisango and I am currently working on a study **on the adoption and use of ICTs at secondary schools.** This study is carried out here at your school which was selected by approaching the Sedibeng West District Department of education. The department informed me that this school was given information and communication technologies (ICTs) to use during the teaching and learning process. I would like to find out your experiences when using the technology in your school. Please feel free to express yourself during our conversation. You are also free to ask for clarification. If there are any other issues that I might have left out pertaining your use of ICTs in this school, please notify me. All your responses are of value to this research.

When completed, the research findings will be reported to the Gauteng Department of Education. This research might provide valuable information on the adoption and use of ICTs in schools. Such information may be used to inform policy makers and this might improve strategies that are used by the government to encourage the use of ICTs in schools.

I also assure you that our conversation remains confidential and will not in any way be linked to you or to your school. Thus I used alphabets to code your school instead of using the actual name of this school.

INTERVIEW GUIDE FOR SCHOOL PRINCIPALS

1. How do you feel about the use of ICTs in this school?
2. How do you feel your school is doing as far as using ICTs?
3. What problems are you facing in adopting and using ICTs at this school?
4. What do think can be done to counter the ICTs related problems in this school?

Thank you for your participation.

Addendum B: Interview guide for teachers

SEMI-STRUCTURED INTERVIEW GUIDE

INTRODUCTION

My name is Grasia Chisango and I am a University of South Africa student. My study is **on the adoption and use of ICTs at secondary schools**. This study is carried out in this municipality and your school was selected by approaching the Sedibeng West District Department of education. The department informed me that this school was given information and communication technologies (ICTs) to use when you are teaching. I would like to find out your experiences when using the technology in teaching. Please feel free to express yourself during our conversation. You are also free to ask for clarification. If there are any other issues that I might have left out pertaining your use of ICTs in teaching, please notify me. All your responses and suggestions are of value to this research.

When completed, the research findings will be reported to the Gauteng Department of Education. This research might provide valuable information on your experiences of ICTs adoption and used at this school. Such information may be used to inform policy makers and this might improve strategies that are used by the government to encourage the use of ICTs in schools.

I also assure you that our conversation remains confidential and will not in any way be linked to you or to your schools. Thus I used alphabets to code the school instead of using the actual name of the school. I will code your responses instead of using your real names.

INTERVIEW GUIDE FOR TEACHERS

1. How do you feel about the use of ICTs in teaching?
2. How do you integrate ICTs in teaching and learning?
3. What can be done to enhance teachers’ use of ICTs in the classroom?
4. What are the challenges that you are facing in the use of ICTs in teaching and learning?
5. What do you think can be done to solve the identified challenges?

Thank you for your participation.

Addendum C: Survey questionnaire cover letter

3A Hofmeyer Street

Sandringham

Queenstown

5320

01 February 2018

To whom it may concern

Sir/Madam

REF: REQUEST FOR YOUR PARTICIPATION IN MY DOCTORAL STUDIES.

I kindly request that you participate in my doctoral studies.

I am a University of South Africa student studying towards a doctoral degree in Communication Science. My study is on the adoption and use of information and communication technologies (ICTs) at secondary schools. I am conducting research at your school and thus request that you fill in the survey questionnaire. I will collect the questionnaire at your workplace.

Your participation is highly appreciated.

Yours faithfully

Grasia Chisango

Student No. 46476253

Addendum D: Survey questionnaire for teachers

Grasia Chisango

Student 46476253: Department of Communication Science, UNISA, PO Box 392, Pretoria, 0001.

Mobile: 078 352 9063 or 074 838 4744   Email: grasiac@yahoo.co.uk

The following questionnaire is designed to obtain your views about **the adoption and use of ICTs in teaching and learning at your school**. Please answer each question to the best of your knowledge. Your responses will be kept completely confidential. Thank you for your participation.

SECTION A: TEACHERS' DEMOGRAPHIC DATA

Please supply the following personal information. Please mark with an X where applicable.

1. Gender

Male	Female
1	2

2. Ethnicity

Black 1	White 2	Indian/ Asian 3	Coloured 4	Other (specify) 5

3. Age: ………… years

4. Highest academic qualification

Post matric: Certificate/ Diploma 1	Bachelors degree 2	Honours degree 3	Masters degree 4	Doctoral degree 5	Other (specify) 6

5. In which subjects did you specialise in college and/or university. Please respond by putting an (X) appropriately.

	Yes 1	No 2
Languages		
Home language		

First Additional Language		
Second Additional Language		
Sciences		
Mathematics		
Mathematical Literacy		
Natural Sciences		
Physical science		
Life sciences		
Agricultural sciences		
Humanities		
Social sciences		
History		
Geography		
Creative arts		
Tourism		
Consumer studies		
Technical subjects		
Technical Mathematics		
Technical sciences		
Civil Technology		
Electrical technology		
Mechanical technology		
Engineering and graphic design		
Computer Application Technology		
Information Technology		
Commercial subjects		
Economic and Management sciences		
Accounting		
Business studies		
Economics		
Sport		
Other (specify)		

6. Teaching experience:……………. Years

6b. Indicate the rank or position that you occupy at your school by putting an (X) under the appropriate rank

Principal	Deputy-principal	Head of department	Senior teacher	Junior teacher
1	2	3	4	5

7. Indicate the subject that you are currently teaching by putting an (X) against the subject. Please also write the number of years that you have been teaching that subject under the appropriate heading.

		X	**Number of years teaching the subject**
Languages			
Home language	1		
First Additional Language	2		
Second Additional Language	3		
Sciences			
Mathematics	4		
Mathematical Literacy	5		
Natural Sciences	6		
Physical science	7		
Life sciences	8		
Agricultural sciences	9		
Humanities			
Social sciences	10		
History	11		
Geography	12		
Creative arts	13		
Tourism	14		
Consumer studies	15		
Technical subjects			
Technical Mathematics	16		
Technical sciences	17		
Civil Technology	18		
Electrical technology	19		
Mechanical technology	20		
Engineering and graphic design	21		
Computer Application Technology	22		
Information Technology	23		
Commercial subjects			

Economic and Management sciences	24		
Accounting	25		
Business studies	26		
Economics	27		
Sport	**28**		
Other (specify)			

7. Employment status. (Indicate with an X)

Temporary 1	Permanent 2

8. Which of these things do you have access to at home? Indicate (X).

	Yes (Do have access) 1	No (Do not have access) 2
A smart phone		
A computer		
The internet		
A tablet		

9. How often do you use in your daily activities:

	Every day	A few times a week	A few times a month	Less than once a month	Never	Don't know
	6	5	4	3	2	1
A smart phone?						
A computer?						

The internet?						
A tablet						

Comment on any issues raised above

……
……
………………

For what purposes do you use:

A smart phone?

……
……
………………

A computer?

……
……
………………

The internet?

……
……
………………

A tablet?

……
……
………………

SECTION B: AVAILABLE INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) INFRASTRUCTURE AT SCHOOL

For the purposes of this study, ICTs refers to technology used in teaching and learning, such as tablets, computers, the internet and interactive whiteboards.

1. Are the following facilities available at the school you are teaching?

Respond by putting an (X) under the appropriate heading.

Available ICTs for teaching and leaning	Yes 1	No 2

1. A computer laboratory		
2. Tablets		
3. High speed internet		
4. Computers in working order for learners' use		
5. Computers in working order for teachers' use		
6. Interactive whiteboards which can be used by any teacher during teaching		

Comment on any issues raised above

……
……
……………...

2. Information and communication technologies (ICTs) competency

Rate your level of ICT skills by putting an (X) under the appropriate heading.

	Excellent 5	Good 4	Fair capability 3	Low capability 2	No capability 1
1. Word Processing (e.g. Use of programs like MSWord)					
2. Spreadsheets (e.g. Use of programs like excel)					
3. Presentation tools (e.g. Use of programs like PowerPoint)					
4. e-mailing					
5. Internet browsing					
6. Statistical tools					

Comment on any issues raised above

……
……
………………

3. How often do you use the following computer applications in your teaching? Put an (X) under the appropriate heading.

Computer applications	All the time 5	Often 4	Sometimes 3	Seldom 2	Never 1
1. Use of the spreadsheets (e.g. excel)					
2. Use of internet browsing					
3. Use of presentation tools (e.g. PowerPoint)					
4. Use of teaching courseware (e.g. e-books)					
5. Use of graphical visualisation tools (e.g. Keylines)					
6. Use of multimedia/					

hypermedia (e.g. Windows Media Player)					
7. Use of simulation programmes (e.g. learners creating an electric circuit with an online program)					

Comment on any issues raised above

………
………
………………

4. To what extent do you integrate information and communication technologies (ICTs) when teaching?
   Indicate your response with an (X) appropriately.

ICTs integration	To a large extent 4	To a reasonable extent 3	To a small extent 2	Not at all 1
1. I am aware of ICTs available for teaching and learning				
2. I use various ICTs in my teaching				

3. I have access to ICTs that I use in my teaching and learning				
4. I know how to integrate ICTs in my teaching and learning				
5. I use ICTs to actively engage learners				
6. I use ICTs to promote learner to learner interaction (e.g. interaction between learners) during the lesson				
7. I have adequate ICT skills to enable me to use technology in my teaching and learning				

Comment on any issues raised above

………
………
………………

5. ICTs adoption and use in the classroom?

Please respond by putting an (X) to indicate your level of agreement from strongly agree to strongly disagree

	Strongly agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly disagree 1
1. ICTs are disruptive when teaching					
2. ICTs make teaching effective					
3. ICTs promote learner to learner interaction					

4. ICTs help in improving learner performance					
5. Use of ICTs in teaching and learning can improve learners' critical thinking					
6. Knowing how to use ICTs by teachers is a good skill					
7. Use of ICT tools in the classroom is beneficial in teaching and learning of my subject area					
8. ICTs make lesson plans richer					
9. ICTs help teachers save time during lesson preparation					
10. Use of ICTs puts more work on teachers					
11. ICTs arouse learner curiosity in the learning process					
12. ICTs help me to address varying needs of learners					
13. Use of ICTs in teaching is enjoyable					
14. Using ICTs in teaching is difficult					
15. I am hesitant to use ICTs in teaching and learning					

16. I do not believe that the use of ICTs will benefit my teaching					

Comment on any issues raised above

………
………
………………

6. How often do you use the following technologies in your teaching?

Please indicate your response by putting an (X) under the appropriate heading.

	All the time 5	Often 4	Sometimes 3	Seldom 2	Not at all 1
1. Tablets					
2. Computers					
3. An interactive whiteboard					
4. The internet					
5. Social media platforms					
6. Web 2.0 technologies					

Comment on any issues raised above

………
………
………………

7. 1. Please indicate why you use or do not use ICTs in your teaching

………
………
………………

2. What are the benefits that you are experiencing when using ICTs?

……
……
………………

8. How often do you practise the following in your lessons? Indicate by putting an (X) appropriately.

	Always 5	Often 4	Sometimes 3	Lesser extent 2	Not at all 1
1. When I teach, I use methods which encourage learners to create knowledge through ICTs					
2. I use ICTs to engage learners with work that requires investigation of complex questions over a long period of time					
3. I use learner-centred methods when teaching with ICTs					
4. I adapt my teaching methods to suit different learners when teaching using ICTs					
5. I select ICTs which best suit the content that I will be teaching					

6. I assess my learners on an e-learning platform					
7. I track my learners' progress on the e-learning platform					
8. I use ICTs in my lessons to facilitate higher order thinking skills, including problem solving and decision making					
9. I use ICTs in teaching and learning without anyone's help					

Comment on any issues raised above

………
………
………………

SECTION D: ICT TRAINING AND SUPPORT NEEDS OF TEACHERS

1. To what extent does the following apply to you? Indicate by putting an (X) appropriately.

	Large extent 5	Some extent 4	Uncertain 3	Small extent 2	Not at all 1
1. I have been trained on how to use a variety of ICTs in teaching and learning					
2. I have been trained which ICTs are appropriate for the					

subject that I am teaching					
3. The ICT training courses which I received integrate teaching methodology, subject content and the use of technology					
4. I am confident to use ICTs when I teach					
5. I select ICTs that enhance the content that I teach					
6. I use teaching strategies that combine teaching methodology, subject content and the use of technology					

Comment on any issues raised above

……
……
………………

2. How important are the following ICT training and support needs? Indicate by putting an (X) appropriately.

	Very important 5	Somewhat important 4	Neutral 3	Somewhat unimportant 2	Unimportant at all 1
Professional development course					
ICT seminars					
ICT support personnel					

Comment on any issues raised above

……
……
………………

SECTION E: CHALLENGES IN THE ADOPTION AND USE OF ICTs IN TEACHING AND LEARNING

1. How important are the following barriers to the adoption and use of ICTs in your school? Indicate by putting an (X) appropriately.

	Not an important barrier at all 5	Less important barrier 4	Important barrier 3	High important barrier 2	Very high important barrier 1
1. Inadequate training on ICT use in the teaching of my particular subject					
2. Lack of a school-based technician					
3. Limited supply of electricity					
4. Limited access to high speed internet					
5. Lack of educational software for my particular					

subject (e.g. games)					
6. Lack of time					
7. Limited support from the school management team					
8. Limited support from the government					
9. Negative teacher attitudes towards the use of computers in teaching and learning					
10. Challenges to integrate ICTs in teaching					
11. Lack of confidence to use ICTs in teaching					
12. Lack of motivation to use ICTs in the classroom					
13. Inadequate maintenance of ICT hardware					

14. Limited access to ICTs among learners during teaching and learning					
15. Limited ICT skills among learners					
16. Limited ICT skills among teachers					

Comment on any of the issues raised above

………
………
………………

SECTION F: POSSIBLE SOLUTIONS FOR THE CHALLENGES AFFECTING THE ADOPTION AND USE OF ICTs IN SCHOOLS.

1. May you please suggest possible solutions to the challenges that you are facing in the adoption and use of ICTs in your school.

…………………………………………………………………………………………
…………………………………………………………………………………………

Thank you for completing the questionnaire.

Addendum E: Gauteng Provincial Department of Education: Permission Letter

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	**16 November 2017**
Validity of Research Approval:	**05 February 2018 – 28 September 2018** **2017/319**
Name of Researcher:	**Chisango G**
Address of Researcher:	**3A Hofmeyer Street**
	Sandringham
	Queenstown 5320
Telephone Number:	**074 838 4744 078 352 9063**
Email address:	**graslac@yahoo.co.uk**
Research Topic:	**The adoption and use of Information and Communication Technologies (ICT's) in teaching and learning in township secondary Schools in Sedibeng District Municipality**
Number and type of schools:	**Seven Secondary Schools**
District/s/HO	**Sedibeng West**

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

17/11/17

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Addendum F: Gauteng Provincial Department of Education Permission Letter

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	02 April 2019
Validity of Research Approval:	04 February 2019 – 30 September 2019 2018/444
Name of Researcher:	Chisango G
Address of Researcher:	3A Hofmeyer street
	Sandringham
	Queenstown 5320
Telephone Number:	078 352 9063
Email address:	grasiac@yahoo.co.uk
Research Topic:	The Adoption and use of Information and Communication Technologies (ICTs) in Teaching and Learning at Township Secondary Schools in Sedibeng West District Municipality
Type of qualification	PhD
Number and type of schools:	Four Secondary Schools
District/s/HO	Sedibeng West

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the

02/04/2019 1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

Addendum G: Ethical clearance

UNISA university of south africa

UNISA COMMUNICATION SCIENCE ETHICS REVIEW COMMITTEE

Date 6 May 2019

Dear Ms Grasia Chisango

NHREC Registration #: Rec-240816-052

ERC Reference # :2019-COMMSCIENCE-CHS-46476253

Name: G Chisango

Student #:46476253

Decision:
Ethics Approval from 6 May 2019 to 7 May 2024

Researcher(s): Ms G Chisango

Supervisor (s): Prof E Bornman

Department of Communication Science

University of South Africa

Bornme@unisa.ac.za

083 459 7191

Working title of research:

THE ADOPTION AND USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN TEACHING AND LEARNING AT TOWNSHIP SECONDARY SCHOOLS IN SEDIBENG WEST DISTRICT MUNICIPALITY

Qualification: PhD in Communication

Thank you for the application for research ethics clearance by Department of Communication Science Ethics Review Committee for the above mentioned research. Ethics approval is granted for five years.

*The **low risk application** was **reviewed** by the Departmental Ethics Review Committee on **19 February 2019** in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment. The decision was tabled at the Committee meeting on **30 April 2019** for approval.*

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the **Communication Science Ethics Review Committee**.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date (**7 May 2024**). Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **2019-COMMSCIENCE-CHS-46476253** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely

Signature :

Mr Siyabonga M Mfuphi
Ethics Chair :
Communication Science Ethics Review Committee

Signature :

Dr Suryakanthie Chetty
Ethics Chair : CREC
E-mail : chetts@unisa.ac.za

Addendum H: Consent to participate in this study

I, __________________ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname………………………………………… (please print)

Participant Signature…………………………………………..Date…………………

Researcher's Name & Surname………………………………………(please print)

Researcher's signature…………………………………………..Date…………………

Addendum I: Participant information sheet

Ethics clearance reference number: 2019-COMMSCIENCE-CHS-46476253
Research permission reference number: 8/4/4/1/2

02 April 2019

Title: The adoption and use of information and communication technologies (ICTs) in teaching and learning at township secondary schools in Sedibeng West district municipality

Dear Prospective Participant

My name is Grasia Chisango and I am doing research with Prof E Bornman, a professor, in the Department of Communication Science towards a Doctor of Literature and Philosophy in Communication Science at the University of South Africa. We are inviting you to participate in a study entitled: The adoption and use of information and communication technologies (ICTs) in teaching and learning at township secondary schools in Sedibeng West District Municipality.

WHAT IS THE PURPOSE OF THE STUDY

This study is expected to collect important information that could assist the department of education officials in realising the extent at which the technology that they have rolled out to some schools has benefitted teaching and learning. This study could also bring to light technology challenges that teachers might be facing at schools. Findings from this study might inform education policy makers.

WHY AM I BEING INVITED TO PARTICIPATE?

I applied for permission to conduct my study at the department of Education. With the help of the department of education officials, I chose schools which were given ICTs by the Gauteng Provincial Department of Education to use in teaching and learning. When permission was granted by the provincial office, I then went with the permission letter to school principals. I however did not ask for your personal contact details and your names since that is not necessary in this study. Each group of participants consists of eight teachers.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

The study involves both focus group discussions and a survey questionnaire. The focus group discussions can be voice-recorded if all participants agree.
The questions that you will be asked during the focus group discussions are as follows:

1. How do you feel about the use of ICTs in teaching?
2. How do you integrate ICTs in teaching and learning?
3. What can be done to enhance teachers' use of ICTs in the classroom?
4. What can be done to enhance teachers' use of ICTs in the classroom?
5. What are the challenges that you are facing in the use of ICTs in teaching and learning?
6. What do you think can be done to solve the identified challenges?

The focus group discussions will take approximately 45 minutes. Completing a survey questionnaire will take approximately 15 minutes.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. However, it will not be possible for you to withdraw your questionnaire after submitting it. The questionnaire does not require your name or any form of identity which can be linked to you.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

The potential benefits of taking part in this study are that, the department of education might use the findings of this study in evaluating the extent schools have benefitted from using information and communication technologies. The study might also bring the classroom realities that might not be known by department of education and the society at large. If for instance, there are any challenges that teachers might be facing when using technology in the classroom, it then becomes possible for the relevant authorities to rectify the problems.

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

This study will be conducted during teaching breaks and it might be an inconvenience to the participant. Focus discussions might cause some discomfort if some participants disrespect others' views. However the researcher will ask participants to respect each person's responses.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

In this study, the researcher will not ask for your name. It is only the researcher who will know about your participation in this research. No-one will be able to connect you to the answers you give. She will code each focus group as well as the school. Your questionnaires will also be coded by the researcher and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

The researcher for this study will take field notes during the focus group discussions.

Your anonymous data might be used for other purposes such as a research report, journal articles and conference proceedings. In these publications, the researcher will use codes instead of your names. Responses from focus group discussions will be coded, for example, Focus Group 1 at School A, will be coded as (SAFG1). The same applies to your questionnaire, it will be coded, for instance, School A Teacher 1 (SAT1). The code will be used to identify your responses and not your name.

While every effort will be made by the researcher to ensure that you will not be connected to the information that you share during the focus group, I cannot guarantee that other participants in the focus group will treat information confidentially. I shall, however, encourage all participants to do so. For this reason I advise you not to disclose personally sensitive information in the focus group discussion.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies (questionnaires) of your answers will be stored by the researcher for a minimum period of five years in a locked cupboard at home in Queenstown for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded and burnt. Electronic copies, will be permanently deleted from the hard drive of the computer through the use of a relevant software programme.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

You will not receive any payment or incentive for participating in this study.

HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received written approval from the Research Ethics Review Committee of the *[identify the relevant ERC],* Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Grasia Chisango on 0783529063 or grasiac@yahoo.co.uk. The findings are accessible for a year. Should you require any further information or want to contact the researcher about any aspect of this study, please contact Grasia Chisango on 0783529063 or grasiac@yahoo.co.uk.

Should you have concerns about the way in which the research has been conducted, you may contact Professor E Bornman on 0834597191 or bornme@unisa.ac.za. Contact the research ethics chairperson of the Departmental Ethics Review Committee, Siyabonga Mfuphithe on 012 429 8264 or mfuphsm@unisa.ac.za.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

G.Chisango

Grasia Chisango

Addendum J: Editor's report

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29 July 2019

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TO WHOM IT MAY CONCERN

Re: Confirmation of Editing of Grasia Chisango's Doctoral Thesis

This is to certify that I, **Prof. Rugare Mareva** (National Identity Number 22-101 400 k 22), have edited **Grasia Chisango's** Thesis titled: **The adoption and use of Information and Communication Technologies (ICTs) in teaching and learning at township secondary schools in Sedibeng West District Municipality,** to be submitted to the University of South Africa (UNISA**).** I am a holder of: a PhD (English) (University of Venda); M.Ed (English) (University of Zimbabwe); B.Ed (English) (University of Zimbabwe), and a Certificate in Education (University of Zimbabwe).

Thank you

Prof. Rugare Mareva (PhD)

Addendum K: Turnitin report including Sources Consulted